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RESEARCH ARTICLE

QUALITY OF LIFE AMONG HEART FAILURE PATIENTS - AEROBIC EXERCISE TRAINING AND INSPIRATORY MUSCLE TRAINING PROGRAMMES

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ABSTRACT

Heart failure is associated with significantly reduced physical and mental health, resulting in a markedly decreased quality of life. With the exception of heart failure caused by reversible condition, the condition usually worsens with time. People with heart failure are living longer but with disabling dyspnea that erodes quality of life. A study has been carried out to determine the effectiveness of aerobic exercise training, inspiratory muscle training and combined training programmes on improvement of quality of life among heart failure patients in selected cardiac rehabilitation centers of Dakshina Kannada District. The results showed that there was a significant improvement in the mean scores of Minnesota Living With Heart Failure Questionnaire after aerobic exercise training 2.03 ($p< 0.05$), inspiratory muscle training 2.02 ($p< 0.05$), and combined training 2.02 ($p< 0.05$), programmes by using Wilcoxon signed rank test. The study concluded that the aerobic exercise training and inspiratory muscle training programmes can be chosen as alternate therapy for improving or maintaining overall quality of life among heart failure patients by improving both strength and endurance of respiratory muscles.

INTRODUCTION

Heart failure is a condition in which a problem with the structure or function of the heart impairs its ability to supply sufficient blood flow to meet the body's needs. Heart failure is a common, costly, disabling and deadly condition. In developing countries around 2% of adults suffer from heart failure, but in those over the age of 65, this increases to 6-10%.[1]

People with heart failure are living longer but with disabling dyspnea that erodes quality of life. Decreased strength of inspiratory muscles may contribute to dyspnea in heart failure, and inspiratory muscle training has been shown to improve the strength of inspiratory muscles. [2]

Low inspiratory muscle strength has been hypothesized to contribute to the often disabling dyspnea that erodes quality of life in persons living with heart failure. Inspiratory muscle training, an intervention for another chronic health condition with similar dyspnea symptoms, may provide patients with heart failure with a home-based method for improving or maintaining their quality of life. [2]

Inspiratory muscle weakness is prevalent in patients with chronic heart failure caused by left ventricular systolic dysfunction, which contribute to reduced exercise capacity and the presence of dyspnea during daily activities. Inspiratory muscle strength has independent prognostic value in congestive heart failure. Results of trials with inspiratory muscle training indicate that this intervention improves exercise capacity and quality of life, particularly in patients with congestive cardiac failure and inspiratory muscle weakness. Inspiratory muscle training results in improved cardiovascular responses to exercise and to those obtained with aerobic training. These findings suggest that routine screening for inspiratory muscle weakness is advisable in patients with congestive cardiac failure, and specific inspiratory muscle training and/or aerobic training are of practical value in the management of these patients. [3]

Literature Survey

A study conducted to determine the prevalence, incidence rate, lifetime risk and prognosis of heart failure shows that the prevalence was higher in men and increased with age from 0.9% in subject aged 55 – 64 years to 17.4% in those aged 85 and the incidence rate increased with age 1.4 per 1000 person-years in those aged 55-59 years to 47.4 per 1000 person-years

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in those aged 90 years. Lifetime risk was 33% for men and 29% for women at the age of 55. Survival after incident heart failure was 86% at 30 days, 63% at 1 year, 51% at 2 years and 35% at 5 years of follow-up. Prevalence and incidence rates of heart failure are high. In individuals aged 55, almost 1 in 3 may develop heart failure during their remaining life span. Heart failure known to be a fatal disease, with only 35% surviving five years after the first diagnosis. [4]

A study conducted on inspiratory muscle weakness and dyspnea in chronic heart failure revealed that the chronic heart failure patients, when compared with their matched control subjects, had reduced inspiratory and expiratory muscle strength and both were significantly correlated with dyspnea during daily activities. There was no correlation between lung volumes or spirometry and dyspnea in heart failure patients. The patients with stable chronic heart failure have inspiratory and expiratory muscle weakness and further suggest that the respiratory muscle pump significantly contributes to the dyspnea during the activities of daily living. [5]

A study was conducted to evaluate the benefit of inspiratory muscle training by using an incremental respiratory endurance test with fixed respiratory workload which was provided by a software with an electronic mouth pressure manometer interfaced with a computer three times weekly for 10 weeks. The results indicate an increase in both maximum inspiratory pressure and sustained maximum inspiratory pressure, increased peak VO_2 after training, reduced dyspnea and resting heart rate and improved quality of life. Inspiratory muscle training using an incremental endurance test successfully increases both inspiratory strength and endurance alleviates dyspnea and improves functional status in congestive heart failure. [6] A study was conducted to demonstrate in 17 patients with moderate to severe heart failure, that exertional dyspnea can be alleviated by improving muscle function through isolated lower- limb aerobic exercise training , which resulted in increased peak torque of leg flexors and reduced ratio of fatigue indicating improved strength and endurance of leg muscles. Duration of exercise at 70% peak VO_2 increased, dyspnea during the submaximal testing was decreased. Minnesota living with heart failure score & transitional dyspnea index were all improved with training. [7]

A study was conducted to determine the effectiveness of group – based aerobic interval training in four patients (55 – 71 years of age) with chronic heart failure with rehabilitation program twice per week for 16 weeks, which revealed that patients one, two & three increased their aerobic capacity (17%, 25% & 52% respectively) and patient four did not complete the exercise because of limitations associated with his pacemaker. All patients increased their six minute walk test distance and experienced improvements in physical capacity and quality of life and had no adverse events. [8] A study was conducted on combined aerobic and resistance exercise training to improve functional capacity and strength in congestive heart failure revealed that peak exercise oxygen uptake increased after the eight week program, sub- maximal exercise heart rate was lower after training, whereas ventilatory threshold and maximal isotonic voluntary contractile strength are increased. An exercise prescription specially targeting peripheral abnormalities in CHF, improves functional capacity and muscular strength in these patients. [9]

Objectives of the study

The objectives of the study were to:

- measure the overall quality of life among heart failure patients before and after the interventional programmes.
- compare the inspiratory muscle strength and severity of dyspnea in heart failure patients before and after the interventional programmes, i.e, inspiratory muscle training, aerobic exercise training or combination training (of both).

Hypotheses

Hypotheses were tested at 0.05 level of significance

H_1: There will be a significant improvement in overall health related quality of life among heart failure patients after the exercise training programmes.

H_2: There will be a significant difference among three experimental groups in overall health related quality of life after the exercise training programme

METHODOLOGY / APPROACH

Research Approach

An experimental research approach is used for this study. An experimental research approach is an applied form of research that involves, finding out how well a practice or procedure is working. [10]

Research Design

In order to accomplish the main objective of assessing the effectiveness of aerobic exercise training and inspiratory muscle training on overall quality of life among heart failure patients, a pre-test – post-test three group design is adopted. Pre-test was administered after ensuring that the patients are physically fit to undergo the training programme. Physical fitness was assessed by physical examination of the patients and by 6 minutes walk test.

GROUP I	R	O_1	X	O_2
GROUP II	R	O_1	X	O_2
GROUP III	R	O_1	X	O_2

Group I – five heart failure patients who are undergoing aerobic exercise training program

Group II – five heart failure patients who are undergoing inspiratory muscle training program

Group III – five heart failure patients who are undergoing both aerobic exercise training and inspiratory muscle training programs.

R = Randomization of subjects

X = Interventions (aerobic exercise training program, inspiratory muscle training program and combined training programs)

O_1 = First observation on overall quality of life before demonstrating exercise programme.
O_2 = Second observation on overall quality of life after treatment of 4 weeks.

Variables

Variables are also concepts at different levels of abstraction that are concisely defined to promote their measurement or manipulation within a study.[11]

The following variables were identified in the present study:

Independent Variables

Aerobic exercise training programme and inspiratory muscle training programme and the combined training programme.

Dependent Variables

Overall health related quality of life.

Setting of the Study

The study was conducted in selected cardiac rehabilitation centers of Dakshina Kannada District.

Population

The population selected for the study comprised of heart failure patients from selected cardiac rehabilitation centers of Dakshina Kannada District.

Sample

In this study, the sample consists of 15 heart failure patients. i.e., 05 samples in each of the experimental group.

Sampling Technique

In this study purposive sampling technique is used to select the heart failure patients and samples are randomly assigned to each experimental group and are represented in **figure 1.**

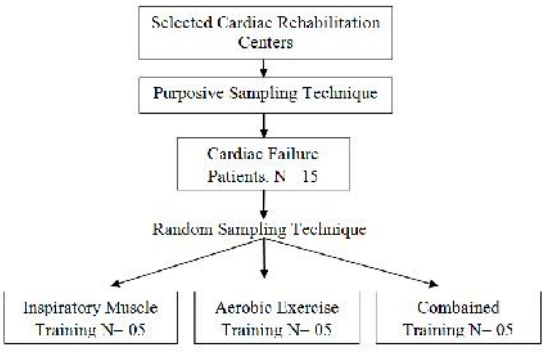

Figure 1 The Sampling Plan

Sampling Criteria

Inclusion Criteria

Heart failure patients who are

- diagnosed as heart failure for more than 6 months.
- experiencing dyspnea within a range of 2-10 on Borg Dyspnea Scale.
- less than 80 years of age.
- willing to participate in the study.
- found to be physically fit following a physical assessment & 6 MWT.

Exclusion criteria

Heart failure patients who are

- with history of pulmonary disease .
- with history of current smoking.
- suffering from angina pectoris.
- with recent myocardial infarction or cardiac surgery (< 6 months).
- with history of orthopedic or neurological diseases.
- under treatment with steroids.
- suffering from deep vein thrombosis.

Data Collection Instruments

The following instruments were used for the collection of data:

1. Demographic proforma
2. Inspiratory Muscle Trainer (Power Breath)
3. Borg Dyspnoea Scale
4. Minnesota Living With Heart Failure Questionnaire

Development/Selection of Data Collection Tools

The data collection tools were used for the study are:

1. Demographic Proforma: that consists of age, sex, duration of illness, occupation, history of other respiratory illness and practice of regular exercises of heart failure patients undergoing interventional programmes.
2. A Power Breath was used to measure the inspiratory volume and to give inspiratory muscle training.
3. A Borg Dyspnea Scale was used for identifying severity of dyspnea for selecting the samples.
4. Minnesota Living with Heart Failure Questionnaire used for assessing overall quality of life among heart failure patients before and after the interventional programmes.

Demographic Proforma

Content validity

Demographic proforma was prepared with six items, that is age, sex, duration of illness, occupation, history of other respiratory illness and regular exercises for heart failure patients and were given for validation to 7 experts along with

letter seeking suggestion of experts to validate the tool, acceptance form for tool validation and criteria check list for validation of the tools. Experts were from the field of medicine, physiotherapy and nursing.

Inspiratory Muscle Trainer

Pre – testing and reliability

Inspiratory Muscle Trainer was administered to ten heart failure patients who were fulfilling the sampling criteria, for pre – testing. For establishing reliability, checked the calibration of the Inspiratory Muscle Trainer.

Borg Dyspnea Scale

Standardized Borg Dyspnea Scale with 11 items was used to assess the severity of dyspnea[12] for selecting and including samples in the study.

Test retest method was used to check reliability. r (10) = 1.00. The scale ranging from 0 to 11 was explained to patient and asked the patient to mark on the score for his/her perceived level of dyspnoea.

Minnesota Living with Heart Failure Questionnaire

A standardized tool of Minnesota Living with Heart Failure Questionnaire in its Kannada translation with 21 items was used for assessing quality of life among cardiac failure patients. Test retest method with Spearman's rank correlation coefficient was used. r (10) = 0.962 and tested internal consistency by Cronbach's alpha (α) = 0.831.

Development of Training Programme

The protocols of the training programmes were developed by the researcher after undergoing certified training courses on aerobic exercise training and inspiratory muscle training from certified institutions. The protocols of the training programmes were given to the experts from the field of cardiology, pulmonary medicine and physiotherapy to seek their suggestions. This training programme was demonstrated and taught to the patients after considering their psycho-social factors.

Inspiratory Muscle Training Programme

Inspiratory exercise training programme in order to strengthen the inspiratory muscles by using threshold inspiratory muscle training device (Power Breath) for 4 weeks, 30 minutes, every alternative days, with an inspiratory load at 30% of maximal inspiratory muscle pressure (Pi max).

Aerobic Exercise Training Programme

In this study it refers to a supervised exercise programme with light music, performed 3 times per week, for 4 weeks with duration of 30 minutes including 5 minutes warm up and 5 minutes cool down periods.

Combined Training Programme

Combined Training Programme is with different exercise programmes, which are inspiratory muscle training by using threshold inspiratory muscle training device alternative days for 30 minutes and aerobic exercise training by using light music with supervised exercise steps on every alternate days for 30 minutes for a period of 12 weeks.

Data Collection

A formal letter was sent to the Managing Director of Yenepoya Specialty Hospital, Kodiabail, Mangalore in seeking permission to conduct study among 10 cardiac failure patients with 5 in each of the experimental group on 18/12/13. Ten patients were selected for the study by using purposive sampling technique and selected samples were randomly assigned to three interventional groups. The informed consent was taken prior to the study from subjects and the nature of the study was explained.

The tools were administered to the samples and they took an average time of 30 minutes to complete all. i.e, 5 minutes for Demographic Proforma, 5 minutes for power breath to check inspiratory level, 5 minutes for Borg Dyspnoea Scale, 15 minutes for Minnesota Living with Heart Failure.

Subjects underwent assessment of other parameters like 6 MWT, Spo2, temperature, pulse, respiration and blood pressure. Followed by pretest subjects were demonstrated with exercise programmes. Aerobic exercise training took about 30 mts and inspiratory muscle training took about 20 mts for demonstration. Exercise training programmes were given every alternative day. i.e. patients were practicing Aerobic exercise training and inspiratory muscle training programmes 3 times in a week.

Exercise training programmes were given for 4 weeks and post test tools were administered at the end of 4 weeks. Likert Scale opinionnaire was administered to the patients at the end of exercise training programmes in order to find out their opinion on acceptability of exercise programmes and the tools are as found to be feasible and practicable.

RESULTS

The data was analyzed using descriptive and inferential statistics.

The findings of the study has organized as in the following headings.

Section I: Sample Characteristics

Section II: Effectiveness of inspiratory muscle training, aerobic exercise training and combined training programmes in improving overall health related quality of life.

Section III: Comparison of improvement in overall health related quality of life after the exercise training programmes among three experimental groups.

Section 1: Sample characteristics.

This section deals with the demographic variables of 15 heart failure patients in terms of frequency and percentage.

Table1 frequency and percentage distribution of demographic characteristics of samples. N = 5+5+5=15

Variables	Demographic Data	Interventional Groups						Total frequency	Percentage
		Aerobics		Inspiratory muscle training		Combined training programme			
		f	%	f	%	f	%		
Age	a) 40 to 50	2	40	1	20	2	40	5	33.3
	b) 51 to 60	2	40	1	20	2	40	5	33.3
	c) 61 to 70	-	-	2	40	-	-	2	13.3
	d) 71 to 80	1	1	1	20	1	20	3	20
Sex	a) Male	3	60	3	60	2	40	8	53.3
	b) Female	2	40	2	40	3	60	7	46.7
		-		-	-	1	20	1	6.7
Occupation	a) Professional	3	- 60	1	20	-	-	4	26.7
	b) Clerical,shop owner, farmer	-	-	-	-	-	-	-	-
	c) Skilled worker		-						
	d) Unskilled worker								
	e) Unemployed	-	- 40	1	20	-	-	1	6.7
		2		3	60	4	80	9	60
Duration of illness	a) ≤ 1 year	1	20	1	20	1	20	3	20
	b) 1 to 3 years	2	40	4	80	3	60	9	60
	c) 3 to 5 years	2	40	-	-	1	20	3	20
	d) ≥ 5 years	-	-	-	-	-	-	-	-

Description of demographic variables

Age

Majority of the heart failure patients (66.6%) were in the age group of 40 – 60 years of life.

Gender

Around 53.3% of heart failure patients were males.

Occupation

Around 26.7% of the heart failure patients were employed as Clerical staff, shop owner or farmer.

Duration of illness

Majority of the patients (60%) were suffering from heart failure since 1 to 3 years.

History of other respiratory illness

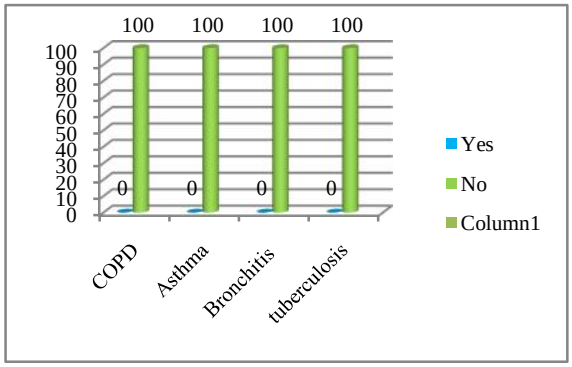

Figure 1 Cylinder diagram showing the distribution of patients according to history of other respiratory illness

None of the patients were with history other respiratory illnesses than which was occurred secondary to heart failure.

A few numbers of patients (33.33%) were practicing daily walking as their regular exercise.

Practice of regular exercises

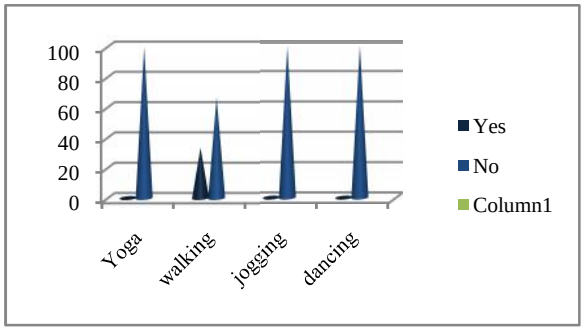

Figure 2 Cone diagram showing the distribution of patients according to practice of regular exercises

Section II Effectiveness of inspiratory muscle training, aerobic exercise training and combined training programmes in improving overall health related quality of life.

This section deals with pretest and post test scores of patients measured by using Minnisotta Living with Heart Failure Questionnaire in order to assess the significant improvement in overall health related quality of life among heart failure patients after the exercise training programmes. In order to find the significant pre test to post test changes in overall health related quality of life, Wilcoxon signed rank test was computed. It is a non-parametric statistical hypothesis test used when comparing two related samples, matched samples, or repeated measurements on a single sample to assess whether their population mean ranks differ (i.e. it is a paired difference test). The following null hypothesis was stated for analysis.

$H0_1$: There will not be a significant improvement in overall quality of life among heart failure patients after the exercise training programmes.

Table 2 Assessment of pre test and post test scores of overall health related quality of life among heart failure patients in all the experimental groups.

Parameter	Groups	Pre test – post test	N	Minimum	Maximum	Mean	Mean Pre – post	Standard deviation	Wilcoxon signed rank test value	P value
Minnesota Living with Heart Failure Questionnaire Overall Quality of Life	Group I	Pre	5	71	89	80.40	55.20	5.76	2.03	0.042*
		Post	5	10.0	32.0	25.20				
	Group II	Pre	5	81	91	85.00	60.20	5.67	2.02	0.043*
		Post	5	18.0	30.0	24.80				
	Group III	Pre	5	67	93	83.00	59.60	9.21	2.02	0.043*
		Post	5	12.0	36.0	23.40				

z = 1.96, p < 0.05 (* significant at 0.05 level of significance)

There was a significant increase in the overall health related quality of life among heart failure patients after aerobic exercise training (2.03, p<0.05), inspiratory muscle training (2.02, p<0.05) and combined training programme (2.02, p<0.05). Since all p values are <0.05, null hypothesis rejected and accepted research hypothesis. i.e; there will be a significant improvement in overall health related quality of life among heart failure patients after the exercise training programmes.

Section III: Comparison of improvement in overall health related quality of life after the exercise training programmes among three experimental groups.

In order to find the significant difference on overall health related quality of life among three experimental groups, Kruskal Wallis test was computed. It is a non-parametric method used for comparing two or more samples that are independent, and that may have different sample sizes, and to compare when there are more than two groups. The following null hypothesis was stated for analysis.

$H0_2$: There will not be a significant difference among the three experimental groups in improving overall health related quality of life after the exercise training programmes.

Table 3 Comparison of improvement in overall health related quality of life among three experimental groups.

Parameter	Groups	Pre – Post mean±SD	Change %	Kruskal walli's test value	P value
Minnesota Living with Heart Failure Questionnaire Overall Quality of Life	I	55.20±5.76	68.66	2.08	0.354
	II	60.20±5.67	70.82		
	III	59.60±9.21	71.81		

Data in table 3 shows that according to χ^2 value (2.08, p>0.05) there was no significant difference between three experimental groups on improvement of overall health related quality of life scores after exercise training programmes, p=0.354. Hence null hypothesis $H0_2$ was accepted, i.e; there will not be a significant difference among the three experimental groups in improving overall health related quality of life after the exercise training programmes.

CONCLUSION

The findings of the study revealed that aerobic exercise training and inspiratory muscle training programmes are effective in improving overall health related quality of life among heart failure patients.

All the three groups have shown almost equal improvement in overall health related quality of life after the exercise training programmes.

Implications

The exercise training improves exercise capacity and overall health related quality of life in patients with heart failure. At present exercise training is only recommended in those patients with stable heart failure and NYHA functional class II or III, and each protocol being tailored to individual needs.

Due to lack of research there is little evidence of benefit in certain groups (more severe patients, elderly people, and women) who may then subsequently be omitted from programmes. The findings are based on small trials in patients who are unrepresentative of the total population of patients with heart failure. The effectiveness of exercise training on functional capacity and quality of life is clear in the short term but is unknown in the longer term.

Large, long-term pragmatic trials of exercise training are needed to determine the effectiveness of exercise training on morbidity, quality of life, and mortality. The value of continued exercise training for maintenance of benefit also requires evaluation.

Future Scope

- The findings of the study will help to utilize inspiratory muscle training and aerobic exercise training as an adjuvant therapy for increasing inspiratory muscle strength and dyspnea and thereby improving overall health related quality of life among heart failure patients.
- The evidence on improved overall health related quality of life would help heart failure patients to perform their activities of daily living more easily and lead a hopeful life ahead.
- Since the outcome shows improved overall heath related quality of life following aerobic exercise & inspiratory muscle training programmes justifies the inclusion of these to cardiac rehabilitation programs.
- Based on the result of this study the exercise programmes can be termed to be safe intervention in rehabilitation programs in heart failure patients with pacemaker.

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