Comparison of the Effects of Different Physical Exercise Programs on the Functional Capacity of Patients with Heart Failure

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Abstract

This study aims to compare the effects of Tai-Chi, treadmill, and stationary bicycle exercises on the capacity of heart function in patients with heart failure. The study was conducted at the outpatient clinic specific for Integrated Heart Service for 12 weeks. The research subjects included 40 respondents. Group 1 was given Tai-Chi exercise, group 2 was given treadmill exercise, group 3 was given stationary bicycle exercise, and group 4 was set as the control group. The finding show that all treatment groups had the same effect on the capacity of heart function ($p<0.05$). However, there was one group receiving the most influential effect compared to the other treatment groups, namely the Tai-Chi exercise group, with a value of $p = 0.000$. Based on the results of data analysis, it can be concluded that Tai-Chi exercise has a more significant effect on heart function capacity than treadmills and stationary bicycle exercises.

Keywords: *functional capacity, heart failure physical exercise program, stationary bicycle, tai-Chi, treadmill*

Introduction

Heart failure has been one of the deadliest diseases impacting millions of people worldwide [(1)]. In Indonesia, heart failure contributes to more than 20% of population deaths in 2011. It has been known as the most dominant cause of death [(2),(3)]. In hospitals, the average mortality rate of patients with heart failure is very high despite being given rehabilitation and discharged from the hospitals [(4)]. Recent studies have shown an important factor in the recovery of heart failure, namely increasing the fitness of functional capacity, namely VO2Max or VO2 peak, blood pressure, and heart rate[(5)]. Physiotherapists specializing in cardiovascular diseases have various effective training methods for treating cases of heart failure that affect body function and movements [(6)]. One way to decrease the risk of heart failure is to do a structured and routine exercise by a physiotherapist [(7),(8)]. Until now, physiotherapy has collaboration with Cardiac rehabilitation exercise program after hospitalization that refers to aerobic physical exercise but there has been no research comparing the effect of that is able to compare Tai-Chi, treadmills, and stationary bicycle exercises [(9)]. The three exercise methods are considered very effective and optimal for measuring the impact of functional capacity such as blood pressure, pulse and VO2Max.

Purpose of Research

In this study, we aim to evaluate the overall clinical impact of the exercises and compare them to find out which exercise program has a better impact on heart failure patients from outpatient care at hospital polyclinics in the Balinese population.

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Methodology

Participants

Forty patients (men = 22 and women = 18) were divided into four groups. Group 1 was given the treatment of Tai-Chi exercise (Yang style), group 2 was treated with treadmill exercise, group 3 was given stationary bicycle training and group 4 was set as the control group. All were given exercises twice a week for 12 weeks.

The patients were in the age range of 50 to 60 years with the provisions of the New York Heart Association (NYHA) class I and II, without a history of chronic comorbidities (post-stroke, diabetes mellitus and chronic lung disease). All participants were given education about the risks and benefits of the training. This study was approved by the Medical Research Ethics Commission of UNUD / Sanglah Hospital.

Measurement

The measurement used a 6-minute walking test (6MWT). This running test was evaluated thoroughly and integrated all systems involved during exercises including the pulmonary and cardiovascular system, systemic circulation, peripheral circulation, blood, neuromuscular units, and muscle metabolism [10].

Statistical Analyses

The data description used the Statistical Product and Service Solution (SPSS) program for Windows. Data from the group were tested for Shapiro Wilk-Test normality with a significance level of 0.05. Data on frequency test resulted in indicated the capacity of heart function before and after treatment of all study groups. Finally, Anova post-hoc Duncan was used to find out which variable or group has the most significant impact.

Results

From homogeneity test (Lavene's Test), the blood pressure, pulse and VO2Max of all treatment groups showed p> 0.05 indicating homogeneous data. Meanwhile, the normality test results of the total value of functional capacity before treatment and after treatment in each treatment group showed a p value greater than 0.05 (p> 0.05), which means that the functional capacity value data before and after the treatment were normally distributed. Data which had normal distribution were then tested using the parametric test.

Table 3 shows that the Tai-Chi group had the lowest average blood pressure with a value of 114.76 and the highest was in the control group with a value of 138.65. In terms of the pulse variable, the Tai-Chi exercise group had the lowest value of 72.80 and the highest was in the control group with a value of 79.90. On the VO2Max variable, the control group showed the lowest VO2Max with a value of 25.20 and the Tai-Chi exercise combination group showed the highest VO2Max with a value of 34.70.

The average of all groups show that the Tai-Chi exercise group obtained a value of p = 0,000 (p <0.05). This proves that the Tai-Chi exercise group had a significantly different effect than the other treatment groups on the capacity of heart function.

Table 1. Homogeneity and Normality Test Results pre and post Treatment of All Groups

Cardiac Functional Capacity Category	**p Homogeneity Test** (Levene's Test)	**p Normality Test (Kolmogorov-Smirnov)**
pre		0.308
Blood pressure	0.674	
Pulse	0.150	
VO2Max	0.537	
post		
Blood pressure	0.468	
Pulse	0.239	
VO2Max	0.249	

Table 2. Heart Function Capacity Frequency Test in All Groups

Cardiac Functional Capacity Category	Pre	Percentage (%)	Post	Percentage (%)
Blood pressure				
Optimal			20	50.0
Normal	8	16.0	14	38.0
Mild Hypertension	32	84.0	6	12.0
Moderate hypertension				
Severe hypertension				
Isolated Systolic Hypertension				
Pulse				
Very good	6	12.0	27	54.0
Well	33	86.0	12	44.0
Moderate	1	2.0	1	2.0
Less				
VO2Max				
Very Poor				
Poor	28	56.0	5	10.0
Fair	12	44.0	12	24.0
Good			20	60.0
Excellent			3	6.0
superior				

Table 3. Anova Duncan test of group comparisons post treatment

Group After Treatment	Variable(s)		
	Blood pressure	Pulse	VO2Max
Anova	0.000	0.000	0.000
Tai-Chi	114.76[a]	72.80[a]	34.70[c]
Treadmill	134.33[c]	77.20[b]	31.70[b]
Stationary bicycle	126.84[b]	75.70[b]	34.00[b]
Control	138.65[d]	79.90[c]	25.20[a]

Annotation:

1. p value <0.05 is called significantly different or significant

2. Numbers followed by the same notation belong to the same group

3. The notation "a" shows the lowest mean

4. The notation "c" and "d" indicate the highest mean

Discussion

Patients with heart failure tend to experience complex instability of heart function [11]. Generally, the Tai-chi, treadmill, and stationary bicycle exercises provide similar benefits to heart function [12], [13], [14]. In theory, Tai-Chi, treadmill, and stationary bicycle exercises are included in aerobic exercises used to optimize the overall capacity of heart function for heart failure patients [15],[16], [17], [18]. There is evidence explaining the difference between treadmill training with stationary bicycle exercises where both exercises have better effects on blood pressure and VO2Max [19], [20]. Tai-Chi program is effective for improving the fitness of heart function among elderly patients, given that Tai-chi is easy to practice [21], [22]. To determine the intensity of Tai-chi exercise, we measured the participants during the exercise at week 4, week 8, and week 12. Tai-chi group showed different blood pressure, pulse and vo2max responses than the treadmill and static bicycle groups.[17], [23]. In the literature, it is explained that Tai-chi can optimize blood pressure, pulse and vo2max of patients with heart failure. Recent findings show that Tai-chi experts are able to impact heart function from cardiovascular disease which suggests that Tai-chi may be an important alternative medicine for the prevention and treatment of heart failure [24]. One mechanism that explains the changes in heart function is that Tai-chi exercises Have a good effect on brain health and anxiety/ depression reduction [25], [26].

Preliminary evidence supporting this study shows that the difference in impact when the test runs 6 minutes in a controlled clinical trial sample evaluating 100 outpatients proves that functional capacity and quality of life in patients given Tai-chi exercises experienced a greater improvement caused by stable blood pressure and normal pulse [27]. The study also explained that according to data collected from the Framingham Heart Study and other prospective studies, most patients would die within 3 years after cardiac rehabilitation [28]. These preliminary findings suggest that future studies should assess the efficacy of tai chi interventions delivered by the community in increasing overall physical activity and the proportion of heart failure patients who achieve current recommendations for physical exercise (150 minutes of moderate intensity of aerobic physical activity per week) [29], [12], [30]. Other findings also prove that Tai-Chi exercise for 16 weeks has a significant effect of 40% on pulse and VO2Max. This is because Tai-Chi exercises maintain balanced body performance by prioritizing concentration so that the increase in VO2Max is more optimal [31]. Literature or previous research shows that Tai-chi has a high potential to be a safe and effective exercise option for optimizing blood pressure, pulse and VO2Max [32].

Research comparing Tai-Chi, treadmills, and stationary bikes exercises has never been done. Therefore, the results of this study can only be compared with the results of previous studies comparing two exercises. Data from various studies that have been carried out still show different finding and no such research has been published in Asia, especially in Indonesia. Thus, this trial will provide an introduction of the benefit of tai chi as a potential exercise for heart failure patients who cannot or do not want to attend conventional heart rehabilitation programs such as treadmills or stationary bicycle exercises.

Conclusion

From the study conducted for 12 weeks, it can be concluded that among aerobic physical exercises such as Tai-Chi, treadmills, and stationary bicycles exercises, it is found that Tai-Chi exercises have the most significant impact compared to treadmills and static bicycles in optimizing functional capacity of patients with disease heart failure.

Conflict of Interest: The authors declare that there is no conflict of interest related to this study.

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