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Dear Editor-in-Chief SPORT SCIENCE INTERNATIONAL SCIENTIFIC JOURNAL OF  
KINESIOLOGY, **Nihad Selimović** (Travnik, Bosnia&Herzegovina)

I am pleased to submit an original research article entitled "*Tai-Chi Exercise: A Better Alternative for Management of Physical Exercise Programs on Patients with Chronic heart failure*" for consideration of publication in the SPORT SCIENCE. We found many cases of heart failure in Indonesia where the death rate from cardiovascular disease is the highest in the worldwide, and this manuscript is based on our previous research to determine the combine exercise method of cardiac rehabilitation exercises for people with heart failure.

We believe that this manuscript is appropriate for publication by the SPORT SCIENCE because it has a mission to inspire sports education, lecturer in sports, doctors, practitioners, scientists to work towards a common goal of improving the quality of life of the international community to provide a scientific and practical approach. Our text creates a paradigm for future research on the methods of cardiac rehabilitation exercises for people with heart failure and applicable to society at large by reducing the consumption of medicines.

This manuscript has not been published and is not considered for publication elsewhere. We have no conflict of interest to disclose, but if Professor Nihad Selimović, feel that the manuscript is appropriate for your journal, we recommend contacting me (HP: +6281236169696), Email: [agungwahyu@undhirabali.ac.id](mailto:agungwahyu@undhirabali.ac.id). Thank you for your consideration.

Best regards, July 27, 2020



(Agung Wahyu Permadi)

# Tai-Chi Exercise: A Better Alternative for Management of Physical Exercise Programs on Patients with Chronic heart failure

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# TAI CHI EXERCISE: A BETTER ALTERNATIVE FOR MANAGING PHYSICAL EXERCISE PROGRAMMES IN PATIENTS WITH CHRONIC HEART FAILURE

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## ABSTRACT

Cardiovascular disease causes more people to die each year than any other cause. Chronic heart failure has been one of the deadliest diseases impacting millions of people worldwide. Deaths due to chronic heart failure can be reduced through the promotive, preventive, curative, and rehabilitative approach. An important factor in chronic heart failure recovery is to increase cardiac functional capacity fitness. This study aims to measure the effects of tai chi, treadmill, and stationary bicycle exercises on the functional capacity in patients with chronic heart failure. The research respondents total 40, and the study was conducted for 12 weeks. 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 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). A 6-minute walking test (6MWT) was used for the measurement. The Statistical Product and Service Solutions (SPSS) programme for Windows was used for data description. The finding shows that all treatment groups had the same effect on the heart function capacity ( $p < 0.05$ ). 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 bike.

**Keywords:** chronic heart failure, physical exercise programme, tai chi, treadmill, stationary bike, functional capacity

## INTRODUCTION

Chronic heart failure causes more people to die each year than any other cause (Segiet et al., 2019). In 2017, chronic heart failure in Indonesia itself was ranked first as the main cause of death

followed by diabetes mellitus (DM), chronic lung disease and stroke in all age ranges with a diagnosis of chronic or non-communicable diseases (Sumartono, Sirait, Holy, & Thabrany, 2011). It is estimated that morbidity and the number of chronic heart failure patients will continue to increase in the coming year due to fast-growing urbanisation in Indonesia which will cause a very serious

burden on public health (Mao et al., 2017). In hospitals, the average mortality rate of patients with chronic heart failure is very high, despite being given rehabilitation and discharged from the hospitals (Sinan et al., 2019). An important factor in the treatment of chronic heart failure is to increase the cardiac functional capacity fitness, namely VO<sub>2</sub>Max or VO<sub>2</sub> peak, blood pressure, and heart rate (Pandey et al., 2017).

Various efforts have been made by practitioners and academics related to the management and maintenance of chronic heart failure, but these still become obstacles in overcoming the problem of chronic heart failure disease (Permadi, 2020). So far, physiotherapists specialising in cardiovascular diseases have various effective training methods for recovery cases of chronic heart failure that affect body function and movements (Travensolo, Goessler, Poton, Pinto, & Polito, 2018). Physiotherapy has established a collaboration with cardiac rehabilitation exercise programme after hospitalisation which refers to aerobic physical exercise, but there has been no research comparing the effect of tai chi, treadmills, and stationary bike exercises (Dzubur & Poronsky, 2018), (Menezes, Lavie, Milani, Arena, & Church, 2012). In this study, we aim to evaluate the overall clinical impact of the exercises and compare them to find out which exercise programme has a better impact on chronic heart failure patients. So, starting from the problem, this study tries to focus on finding which group is the best by comparing of exercise programmes.

## METHODS

### Study Design

The respondents (men = 22 and women = 18) were patients or clients who were diagnosed with chronic heart failure at the outpatient clinic at Sanglah General Hospital, located specifically at the Integrated Heart Service, Denpasar, Bali. All were given exercises twice a week for 12 weeks. In this study, 40 patients were divided into four groups. Group 1 was given the treatment of tai chi exercise (Yang style), group 2 was treated with treadmill exercise (low - Bruce protocol), group 3 was given stationary bicycle training (YCMA), and group 4 was set as the control group. The patients were in the age range of 45 to 65 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 educated on the risks and benefits of the training. During the follow-up, all patients received 6MWT. Informed consent was obtained from the participants before they took part in the study. This study has been tested through a review of proposals involving human subjects and it has been approved by the Research Ethics Committee of the Udayana University Medical School or Sanglah Hospital.

### Measurement

A 6-minute walking test (6MWT) was used for the measurement. This running test was evaluated thoroughly and it integrated all the systems involved during exercises, including the pulmonary and cardiovascular system, systemic circulation, peripheral circulation, blood, neuromuscular units, and muscle metabolism (Babu, Desai, Maiya, Guddattu, & Padmakumar, 2016). Patients were given training for 24 meetings according to each group. Then, the patients were retested for evaluating the heart function capacity, which was then tested for data analysis. The Statistical Product and Service Solutions (SPSS) programme for Windows was used for data description. The data obtained from the group were tested by a Shapiro-Wilk normality test, with a significance level of 0.05. Data on the frequency test results indicated the heart function capacity before and after the treatment of all study groups. Finally, a Duncan post-hoc ANOVA was used to find out which variable or group has the most significant impact.

### Statistical Analyses

The data were analysed using SPSS for Windows. A normality test was used to assess continuous variables for normal distribution fitting, and for normally distributed continuous variables. Duncan post-hoc ANOVA, in this case, was employed to find out which variable or group had the greatest impact on the treatment groups.

## RESULTS

From the homogeneity test (Levene's Test), the blood pressure, pulse and VO<sub>2</sub>Max of all the treatment groups showed  $p > 0.05$ , indicating homogeneous data. Meanwhile, the normality test results of the total value pertaining to 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. The data which had a normal distribution were then tested using the parametric test (Table 1).

In Table 2, good results occurred in research subjects, proving that all treatments, except the control group, had a good impact on blood pressure. In the pulse category, it was found that all treatments had a positive impact on the pulse of the study subjects. A significant impact on the VO<sub>2</sub>Max category after treatment can be seen in several subjects, which proves that all treatments have a very good impact, except those in the control group.

The results of the cardiac functional capacity category before and after treatment (Table 3) show the mean difference of all groups that had a p value less than 0.05 ( $p < 0.05$ ). This showed that, in all groups, there were significant changes before and after treatment. Thus, on average, all treatments had a good impact on blood pressure, pulse, and VO2Max of patients with chronic heart failure.

Table 4 shows that the tai chi group had the lowest average blood pressure of 110.43; the highest (134.32) was measured in the control

group. In terms of the pulse variable, the tai chi exercise group had the lowest value of 68.47, while the highest (75.57) one was measured in the control group. On the VO2Max variable, the control group showed the lowest VO2Max, with a value of 20.87, and the tai chi exercise group showed the highest VO2Max, with a value of 30.37. The average of all groups shows that the tai chi exercise group obtained a value of  $p = 0.000$  ( $p < 0.05$ ), which proves that the tai chi exercise group had a significantly different effect than the other treatment groups on the heart function capacity.

**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)
<b>pre</b>		
Blood pressure	0.674	0.308
Pulse	0.150	
VO2Max	0.537	
<b>post</b>		
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 (%)
<b>Blood pressure</b>				
Optimal			20	50.0
Normal	8	20.0	14	35.0
Mild Hypertension	32	80.0	6	15.0
Moderate Hypertension				
Severe Hypertension				
Isolated Systolic Hypertension				
<b>Pulse</b>				
Very good	6	15.0	27	67.5
Well	33	82.5	12	30.0
Moderate	1	2.5	1	2.5
Less				
<b>VO2Max</b>				
Very Poor				



Poor	28	70.0	5	12.5
Fair	12	30.0	12	30.0
Good			20	50.0
Excellent			3	7.5
superior				

**Table 3:** Comparison Test of Cardiac Functional Capacity Categories Before and After Treatments in All Groups

Cardiac Functional Capacity Category	All Groups		t	p
	Mean	Standard Deviation		
Pre-Treatment Blood Pressure and Post-treatment Blood Pressure	15.8	14.0	8.3	0.000
Pre-treatment pulse and post-treatment pulse	7.1	3.3	9.0	0.000
Pre-VO2Max Post-VO2Max	-6.3	6.1	-10.1	0.000

**Table 4:** Duncan post-hoc ANOVA of post-treatment comparisons

Group After Treatment	Variable(s)		
	Blood pressure	Pulse	VO2Max
<b>ANOVA</b>	0.000	0.000	0.000
Tai chi	110.43 <sup>a</sup>	68.47 <sup>a</sup>	30.37 <sup>c</sup>
Treadmill	130.00 <sup>c</sup>	72.87 <sup>a</sup>	27.37 <sup>b</sup>
Stationary bicycle	122.51 <sup>b</sup>	71.37 <sup>b</sup>	29.67 <sup>b</sup>
Control	134.32 <sup>d</sup>	75.57 <sup>c</sup>	20.87 <sup>a</sup>

Annotation:

1. p value < 0.05 is called significantly different or significant
2. The numbers followed by the same notation belong to the same group
3. The notation "a" shows the lowest mean
4. The notations "c" and "d" indicate the highest mean

## DISCUSSION

Patients with chronic heart failure tend to experience complex instability of heart function (Achttien et al., 2015), (Permadi, 2019). Generally, the tai chi, treadmill and stationary bicycle exercises provide similar benefits to heart function (Zheng, Lal, Meier, Sibbritt, & Zaslowski, 2014), (Krishnaswami et al., 2017). In theory, tai chi, treadmill, and stationary bicycle exercises are aerobic exercises used to optimise the overall capacity of heart function for chronic heart failure patients (Salisbury et al., 2018).

Studies focusing on the three exercises have been conducted, but only one or two comparisons of exercises have been given (Vanroy et al., 2017), (Ma, Zhou, Tang, & Huang, 2018), (Grazzi et al., 2018). There is evidence explaining the difference between treadmill training and stationary bicycle exercises, stating that both exercises have better effects on blood pressure and VO2Max (Bittencourt et al., 2014), (Forestieri et al., 2016).

This study shows that tai chi, treadmills and stationary bicycles exercises impact heart function.

However, our results show that tai chi is better than treadmills and stationary bicycle exercises in patients with chronic heart failure.

A tai chi programme is effective for improving heart function fitness among elderly patients, given that tai chi is easy to practice (G. Li, Yuan, & Zhang, 2014), (J. Li, Hsu, & Lin, 2019). To determine the intensity of tai chi exercise, we measured the participants during the exercise on Week 4, Week 8, and Week 12. The tai chi group showed different blood pressure, pulse and VO<sub>2</sub>max responses than the treadmill and static bicycle groups (Ma et al., 2018), (Ren et al., 2017). In the literature, it is explained that tai chi can optimise blood pressure, pulse and VO<sub>2</sub>max of patients with chronic heart failure (Wong, Chow, & Chung, 2016). Recent findings show that tai chi experts can impact heart function in cardiovascular disease, suggesting that tai chi may be an important alternative medicine for the prevention and treatment of chronic heart failure (Zhang et al., 2019). 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 (Liu, Li, & Shnider, 2010), (Hu et al., 2016).

Preliminary evidence supporting this study shows that the difference in impact when the test is performed for six 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 (Yeh et al., 2011). The study also explained that, according to the data collected from the Framingham Heart Study and other prospective studies, most patients would die three years after cardiac rehabilitation (Salmoirago-Blotcher et al., 2015). 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 chronic heart failure patients who achieve current recommendations for physical exercise (150 minutes of moderate-intensity aerobic physical activity per week) (Huang, Wang, & Wu, 2011), (Zheng et al., 2014), (Lian et al., 2017). Other findings also prove that tai chi exercise performed for 16 weeks has a significant effect of 40% on pulse and VO<sub>2</sub>Max (Liu et al., 2010).

This is because tai chi exercises maintain balanced body performance by prioritising concentration so that the increase in VO<sub>2</sub>Max is more optimal (Almodhy, Ingle, & Sandercock, 2016). Literature or previous research shows that tai chi has a high potential to be a safe and effective exercise option for optimising blood pressure, pulse and VO<sub>2</sub>Max (Chan et al., 2018). 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 findings and no such research has been published in Asia, especially in Indonesia. Thus, this trial provides an introduction to the benefit of tai chi as a potential exercise for chronic heart failure patients who cannot or do not want to attend conventional heart rehabilitation programmes 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 optimising the functional capacity of patients with disease chronic heart failure.

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## **TAI CHI VJEŽBA: BOLJA ALTERNATIVA ZA UPRAVLJANJE PROGRAMIMA TJELOVJEŽBI KOD PACIJENATA SA HRONIČNIM ZATAJENJEM SRCA**

Svake godine, kardiovaskularne bolesti uzrokuju smrt sve više ljudi nego bilo koji drugi uzrok. Hronično zatajenje srca je postalo jedna od najsmrtonosnijih bolesti koja pogađa milione ljudi širom svijeta. Smrtnost prouzrokovana hroničnim zatajenjem srca se može smanjiti promotivnim, preventivnim, kurativnim i rehabilitacijskim pristupima. Važan faktor oporavka od hroničnog zatajenja srca je povećavanje funkcionalne sposobnosti srca. Ova studija ima za cilj izmjeriti efekte vježbanja korištenjem tehnike tai chi, pokretne trake za trčanje i stacionarnog bicikla na funkcionalnu sposobnost pacijenata sa hroničnim zatajenjem srca. Ispitanici istraživanja su brojali 40, a studija je provedena tokom 12 sedmica. Grupa 1 je podvrgnuta tai chi vježbama, grupa 2 je podvrgnuta vježbama na pokretnoj traci za trčanje, grupa 3 je podvrgnuta vježbama na stacionarnom biciklu, a grupa 4 je postavljena kao kontrolna grupa. Pacijenti su bili u starosnom rasponu od 50 do 60 godina, sa odredbama I i II klase Kardiološkog udruženja iz New Yorka (engl. NYHA - New York Heart Association), bez anamneze hroničnih komorbiditeta (stanje nakon moždanog udara, diabetes mellitus i hronična bolest pluća). Za mjerenje se koristio 6-minutni test hoda (6MWT). Za opis podataka se koristio program SPSS (engl. SPSS - Statistical Product and Service Solutions) za Windows. Pronalasci su pokazali da su sve tretirane grupe imale isti efekat na sposobnost rada srca ( $p < 0,05$ ). Međutim, postojala je jedna grupa koja je imala najveći efekat u odnosu na ostale tretirane grupe, i to grupa koja je podvrgnuta tai chi vježbama sa vrijednošću  $p = 0,000$ . Na osnovu rezultata analize podataka može se zaključiti da tai chi vježba ima značajniji uticaj na sposobnost rada srca od vježbi na pokretnoj traci za trčanje i stacionarnom biciklu.

**Ključne riječi:** hronično zatajenje srca, program tjelovježbe, tai chi, pokretna traka za trčanje, stacionarni bicikl, funkcionalna sposobnost

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