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A randomized controlled trial of modified traditional Javanese dance on cardiorespiratory fitness in elderly

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Abstract--The aim of this study is to determine changes of cardiorespiratory fitness in elderly after giving modified Javanese traditional dance for 12 weeks. This study is an experimental study with pre and post-test randomized control group design. The subjects were the elderly woman over 60 years old in the Hargodedali nursing home, Surabaya, Indonesia. Subjects in the treatment group participated in the modified Javanese traditional dance for 12 weeks, 3 times per week with a duration of 35 minutes per session. The control group subjects did not attend the dance session. Six minutes walking test (6MWT) and VO₂ max were measured before before treatment and 12 weeks after treatment was finished. There was a statistically significant increase in VO₂ max value of the treatment group ($p = 0.01$). While in the control group there was a decrease in vo₂ max, but not significant ($p = 0.221$). The effect size of the treatment group is 0.93. There is a significant difference in delta vo₂max between the treatment and control groups ($p=0.004$). The effect size after treatment between groups is 1.4. The adherence of subject in this study is 95.3%. Thus, modified traditional Javanese dance increase VO₂ max for elderly.

Keywords---dance movement therapy, cardiorespiratory fitness, elderly, Javanese dance, VO₂max, 6MWT.

Introduction

Globally the population aged over 65 years is 9%, which is increasing over time, due to the increasing life expectancy (United Nation, 2019). Population in Indonesia in 2018, there were around 24.49 million elderly (Kemenkes, 2014). Data shows the elderly morbidity rate in Indonesia in 2018 was 25.99% (BPS, 2018). Elderly brings physiological changes in all organ systems including the cardiorespiratory system. Changes in the cardiovascular and respiratory systems due to aging will cause a decrease in cardiorespiratory fitness. Maximum oxygen consumption (VO₂ max) as an indicator of cardiorespiratory fitness will decrease with age (Cifu, 2018; Bonder & Bello, 2009) . Most of the elderly show physical inactivity, and have a sedentary lifestyle. Physical inactivity contributes to many health conditions, including decreased cardiorespiratory fitness as assessed by VO₂ max. Low levels of cardiorespiratory fitness are associated with high rates of morbidity and mortality associated with various etiologies, especially cardiovascular disorders (ACSM, 2018). Exercise or physical activity in the elderly can help overcome this problem, but the compliance and interest of the elderly in physical exercise is still very low. Dancing has the potential to be a good and interesting physical activity for the elderly, which can be adapted to the target population of age, physical limitations, and culture (Hwang & Braun, 2017).

Dance movement therapy (DMT) is an alternative exercise for elderly to improve cardiorespiratory function. DMT can also improve the psychological aspects of the elderly which can lead to attachment and adherence to exercises and therapists (Payne, 2003). Indonesia is a country that has various tribes, customs, races, cultures, and religions. Indonesian traditional dance has the potential to be used as an exercise modality to improve physical fitness (Maghfiroh, 2017; Pradewi, 2012; Pertiwi, 2017). Javanese dance is one of the traditional Indonesian dances originating from the Java area which has its own characteristics and rules, which have a variety of movements that involve all parts of the body, so that it is considered to improve physical fitness, include cardiorespiratory fitness (Poerwanto *et al.*, 2019; Kuswardhani *et al.*, 2020). Modified traditional Javanese dance is a dance modification that uses basic traditional Javanese dance movements, which are adapted to the physical capacity of the elderly. The dance is given with a moderate intensity that has been measured previously in the preliminary study, accompanied by Javanese music that is familiar to the research subject. This study aims to determine changes in the cardiorespiratory function of elderly women at the Hargodedali nursing home Surabaya after receiving modified Javanese traditional dance therapy.

Method

This study is a true experimental randomized control group design with a pre and post intervention design. This study uses simple random sampling. This research received ethical approval from the Health Research Ethics Committee, Faculty of

Medicine, Airlangga University with No.26/EC/KEPK/FKUA/2022. All research subjects have signed informed consent.

The study was conducted at the Hargodedali nursing home Surabaya for 12 weeks from February 2022 to May 2022. The subjects of this study were 24 elderly aged over 60 years. The inclusion criteria for this study are: elderly living in the Hargodedali nursing home, female and 60 years or older, MOCA-Ina score more than 20, able to ambulate independently without assistive devices, stable hemodynamics, good visual and hearing function. The exclusion criteria for this study included: the elderly regularly participated in other forms of physical exercise in the last 3 months, Barthel Index Score less than 80, have dementia, have fractures of the upper and lower limbs that interfere with movement and ambulation, have a chronic disease or disease that causes other long-term disability. Subjects can withdraw from the study because: not willing to continue research for any reason, cannot complete the exercise according to the research protocol, experienced shortness of breath, chest pain and complaints related to heart failure that did not improve with rest or taking medication, and died.

The subjects were randomized into 2 groups, treatment group and the control group. Subjects in the treatment group received modified Javanese traditional dance 3 times per week for 12 weeks with moderate intensity (40-60% resting heart rate). The dance session begins with a warm-up exercise in the form of finger gymnastics, joint movements and stretching for 10 minutes accompanied by a slow-tempo national anthem, a core dance with a gradual increase in complexity of motor sequences for 15 minutes accompanied by folk songs with gradually increasing tempo and cooling down in the form of breathing exercises and stretching for 10 minutes accompanied by a slow tempo national anthem. Prior to the 12-week intervention, the patient was given a one-week preparatory class to introduce dance moves. During the intervention, participants were guided by 2 dance instructors, and supervised by 2 doctors and 2 nursing home staff. Subjects in the control group were given education to continue their daily physical activities as usual.

The parameter evaluated in this study was the level of VO_2 max in each group. Measurements were carried out twice, before and after intervention. The initial assessment to determine VO_2 max was carried out with a six minutes walking test (6MWT). The initial evaluation was carried out one day before preparatory class. The final evaluation was carried out one day after the last session. Statistical analysis of this study using SPSS 23.0. The data normality test was performed using Shapiro-Wilk test. To compare VO_2 max before and after treatment in each group, paired T test was used. To compare the differences in pre and post VO_2 max between the treatment and control groups, the independent sample t test was used. The p value is considered significant if $p < 0.05$.

Result and Discussion

Characteristic of Subject

The total subjects of this study were 24 people and all subjects were female. There were 12 subjects in both treatment group and control group. In the final

evaluation, 1 person from the treatment group was drop out because they did not participate in the exercise 3 times in a row and 1 person from the control group was dropout due to death. The final number of subjects analyzed were 11 subjects from the treatment group and 11 subjects from the control group. The initial characteristics of the subject, homogeneity and normality test can be seen in the table 1.

Table 1
Demographic and Clinical Characteristic Subject at Baseline

Variable	Treatment Group (n=12) Mean±SD	<i>p-value</i> (normality)	Control Group (n=12) Mean±SD	<i>p-value</i> (normality)	<i>p-value</i> (homogeneity)
Age (years)	74,72±7,9	0,458	77,09±6,13	0,138	0,646
Body weight (kg)	50,45±12,23	0,467	45±6,41	0,704	0,115
Body height (cm)	153,7±7,47	0,066	148,36±3,04	0,014	0,020
BMI (kg/m ²)	21,19±3,85	0,990	19,97±2,21	0,257	0,243
Systolic Blood Pressure (mmHg)	129,54±14,2 2	0,048	118,18±16,0 1	0,005	0,055
Diastolic Blood Pressure (mmHg)	73,63±10,26	0,054	75,45±6,87	0,002	0,823
Resting heart rate (times/minutes)	67,81±4,11	0,095	67,54±3,14	0,144	0,616
6MWT baseline (m/s)	226,36±88,3 4	0,044	165,45±62,3 4	0,034	0,112
VO ₂ max baseline (ml/kg/minutes)	15,51±4,97	0,136	13,85±3,70	0,767	0,671

6MWT = six minute walking test; VO₂ max : maximum oxygen consumption; Shapiro-wilk normality test = data distribution is normal if $p > 0,05$; homogeneity test = data distribution is homogen if $p > 0,05$

Outcome

The average VO₂ max value of the treatment group before being given a modified Javanese traditional dance was 15.51±4.97 ml/kg/minute and the average after being given exercise for 12 weeks was 17.18±4.34 ml/kg/minute. There was a significant increase in the VO₂ max value in the treatment group ($p = 0.01$) (table 2). In the control group, the mean VO₂ max value at the initial evaluation was 13.87±3.70 ml/kg/min, and the mean VO₂ max value at the final evaluation was 13.63±3.65 ml/kg/min. Based on the paired t test, there was an increase in the VO₂ max value in the control group ($p = 0.221$). The effect size of Modified Javanese Traditional Dance training program for 12 weeks was large (Cohen's D = 0.93).

The mean delta VO₂ max in the treatment group was 1.66±1.78 ml/kg/min, while the control group was -0.42±1.13 ml/kg/min. There was a significant difference in delta VO₂max between the treatment group and the control group (p=0.004) (Table 3). The effect size based on the delta between groups is large (Cohen's D = 1.4). The value of changes in VO₂ max before and after giving the modified Javanese traditional dance training program can be seen in table 3. The average attendance rate of the subjects in the study was 95.3%. From the 12 subjects in the treatment group, only one subject was unable to complete the exercise (dropped out) resulting in a high retention rate of 91.7%.

Table 2
VO₂max pre and post intervention in both group

	Treatment Group (n=11)			Control Group (n=11)		
	Pre intervention	Post intervention	<i>p-value</i>	Pre intervention	Post intervention	<i>p-value</i>
VO ₂ max (ml/kg/minutes)	15,51±4,97	17,18±4,34	0,01*	13,87±3,70	13,63±3,65	0,221

Vomax = maximum oxygen consumption; *paired T-test is meaningful if p<0.05

Table 3
ΔVO₂max in both group

	Treatment Group (n=11)	Control Group (n=11)	<i>p-value</i>
ΔVO ₂ max (ml/kg/minute)	1,66±1,78	-0,42±1,13	0,004*

ΔVO₂ max = delta maximum oxygen consumption; *Independent T-test significant if p<0.05

Discussion

In this study, the age and BMI characteristics of the treatment group and control group were considered homogeneous. VO₂ max decreases with age, 4-5% in active individuals, and 8-10% per 10 years for inactive individuals (Rodrigues *et al.*, 2006). Study by Kalyanshetti & Veluru (2017), an increase in body mass index can reduce cardiorespiratory fitness by assessing VO₂ max. Obesity increases the risk of fatigue during work, the higher the body mass index, the easier it is to experience fatigue. This is because more heat is produced, the ratio of surface area to body volume is getting smaller and heat insulation by fat (Rodrigues *et al.*, 2006). In this study, there were 3 obese patients in the treatment group with low VO₂max value, 2 subject had increasing of VO₂max about 2.3%-37%. This shows that most of the elderly with obesity have a tendency of low VO₂ max, but can increase if given aerobic exercise regularly. Study conducted by Ramos *et al* in 2019 which stated that moderate-intensity aerobic exercise can increase VO₂ max in the elderly with obesity (Ramos *et al.*, 2019).

We used 6 minute walk test (6MWT) to calculate VO₂max. 6MWT is a valid clinical assessment for assessing cardiorespiratory fitness in the elderly (Kervio *et al.*, 2003). There is some formula to get VO₂ max from 6MWT. In this study, we

used the formula from Manttari *et al* in 2018, because it was considered the closest to the characteristics of the subject (Mantari *et al.*, 2018). The results of this study showed that giving a modified Javanese traditional dance training program for 12 weeks was able to significantly increase the VO₂ max value. The average increase in VO₂ max was 1.67 ml/kg/min in the treatment group. The effect size value based on the treatment group's delta is 0.93 which indicates that the modified Javanese traditional dance training program has a large effect on increasing VO₂ max.

The modified Javanese traditional dance training consists of moderate-intensity aerobic exercise (40-60% HRR), 3 times a week for 12 weeks. This prescription consider the initial conditions of the subjects in a very sedentary nursing home. The subjects in this study had not done regular physical exercise since the beginning of the pandemic, which was about 1.5 years. Conventional aerobic exercise that was performed previously was also only given at a low intensity, so we chose a prescription that was more tolerable by the study subjects. The results of this study are in line with research conducted by Hui *et al* in 2008, showing that the elderly were given dance movement therapy (DMT) exercises 2 times per week, for 12 weeks (50 minutes per session, 10 minutes of warm-up, 30 minutes of core dance, 10 minutes of cooling) can improve the six minute walking test (6MWT) better than the control group that was not given the intervention (Hui *et al.*, 2009). Another study by Eyigor *et al* in 2009, with the intervention of Turkish folklore dance 3 times per week with a duration of 1 hour per session, for 8 weeks, can improve functional performance including the 6 minute walking test (6MWT) (Eyigor *et al.*, 2009).

Aerobic exercise consists of repetitive low-resistance movements that engage large muscle groups and increase heart rate over a period of time. The increase in VO₂ max after aerobic exercise in the elderly ranged from 6.6% - 30% (Kalapatharakos, 2007). In this study, the increase in VO₂ max was 10.7%. The author believes that the increase in VO₂ max in this study occurs because the modified Javanese traditional dance movements involve large muscle groups, such as the shoulder muscles (*lembahan, ukel ngrayung, menthang miwir sampur, ndayung, singget menthang*), trunk (*ogek lambung, ongkel pundak, oleng, ogel*) and lower limbs (*jinjit-ungkit kaki, laku lombo*). These movements are repeated, with the intensity, frequency and duration according to the aerobic exercise prescription for the elderly, so as to increase VO₂ max in the elderly after 12 weeks of intervention. Modified Javanese traditional dance also contain elements of music therapy. Music is closely related and forms the basis for the formation of dance movements. This study uses Javanese-themed music according to the characteristics of the research subjects, of which 92% are Javanese. Familiar music will have a more therapeutic effect, especially for the elderly. This is explained through two mechanisms. First, familiar music reduces the demands of cognitive synchronization, so adaptation to movements and beats will be faster. Second, familiar music will make the patient more enjoy the movement so as to achieve the goal of therapy (Leow *et al.*, 2015).

Music therapy can elicit an emotional response because moving with music activates endorphins-related brain's pleasure circuits, and dancing rhythms to music can create a pleasant movement pattern, and distract from fatigue, so that

the elderly can follow the intervention according to the instructions and the exercise goals can be achieved (de Dreu *et al.*, 2012). This study resulted in an increase in the average VO₂ max in the intervention group of 1.66 ± 1.78 or about 10.7% of the initial VO₂ max value. Aerobic exercise is effective if it can increase VO₂ max by 6.6% - 30% (Kalapatharakos, 2007). However, increasing VO₂ max is said to be more effective if it can increase 1 metabolic equivalent/mets or VO₂ max by 3.5 ml/kg/min. An increase of 1 Mets is associated with a 10-25% increase in survival rate, and a reduced risk of cardiovascular disease (Scribbans *et al.*, 2016). So it is necessary to do further research on this intervention with a higher frequency and duration in future studies to be able to increase VO₂ max better.

Patient's Adherence

The average attendance rate in the study was quite good, namely 95.3%. Of the 12 subjects in the treatment group, only one could not complete the exercise (dropped out) according to the criteria, resulting in a high retention rate of 91.7%. The drop out subject did not take part in the exercise 3 times in a row because the person concerned did not want to take part in the exercise for no apparent reason. There are no health problems in this subject that cause not following the exercise. Drop out subjects in the treatment group had a Moca-Ina value of 23, which was included in mild cognitive impairment (MCI). In this study no psychological screening was carried out, so that the incidence of drop out due to psychological disorders could not be explained. Factors associated with a high level of adherence to exercise include good socioeconomic status, marital status, better health conditions, better physical abilities, better cognitive abilities, and fewer depressive symptoms (Rivera-Torres *et al.*, 2019).

The modified traditional Javanese dance is an alternative aerobic exercise, which contains elements of a strong Indonesian tradition, so that it can increase the interest of the elderly for participating in exercise regularly. Dance is also reported more fun for the elderly, improves psychological aspects, integrates physical functions, cognitive and social elements, which provides stimulation of balance, coordination, flexibility, and cardiorespiratory function (Meng *et al.*, 2020; Payne, 2003).

Limitation of Study

The limitations of this study include: 1) this study only took elderly female subjects, 2) this study only assessed the parameters before and immediately after exercise, so the long-term effects of this exercise program are not known, 3) not carried out assessment of daily physical activity and screening for psychological disorders in both the intervention group and the control group.

Conclusion

There is an increase in VO₂ max after modified Javanese traditional dance for 12 weeks to elderly women at the Hargodedali nursing home in Surabaya. There is also delta difference in VO₂ max values in the treatment group that received

modified Javanese traditional dance training for 12 weeks compared to the control group.

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