

Outcomes of Chair Based Exercise with Progressive Resistance Training on Physical Performances among Older Adults: A Preliminary Study (Hasil Latihan Berasaskan Kerusi dan Rintangan Secara Berperingkat ke Atas Prestasi Fizikal di Kalangan Dewasa Tua: Kajian Awal)

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ABSTRACT

Enhancement of physical function had been shown in older adults who actively participate in physical activities, particularly in the form of aerobic training with addition of progressive resistance training (PRT). However, it is quite challenging and risky for most older adults to exercise in standing position without any support. Chair Based Exercise (CBE) is an alternative mode of exercise for older adult to facilitate exercise participation and increase safety. Its effect when combined with resistance training is unknown to date. Therefore, the aim of this study was to evaluate the outcome of CBE with PRT on physical performances among older adults. A total of 18 older adults (13 females (72%) and 5 males (28%)), aged 60 to 83 years with mean age (SD) 72.67 (6.17) years completed the study. All subjects performed CBE with PRT intervention twice weekly for 8 weeks, with individually-tailored exercise progressions. Pre and post measurements of physical performance were performed using Six Minutes Walk Test (6MWT), Five Times Sit to Stand (FTSTS) and Hand Grip Strength (HGS) test. Significant improvement in 6MWT ($p < .001$), HGS Right hand ($p = .043$), HGS Left hand ($p < .001$), FTSTS ($p < .001$) was shown after the eight-week intervention. Adding PRT into seated exercises results in further improvement in physical performance of older adults. CBE-PRT may be recommended as an exercise routine for older adults living in the community.

Keywords: Chair based exercise; Progressive Resistance Training; physical performances; older adults

INTRODUCTION

According to the Malaysian National Policy Division in 2008, older adults are classified as those aged 60 years and above. The number of Malaysian older adults is estimated to be 1.4 million in 2000 and is projected to increase to 3.3 million in the year 2020 (Mafauzy 2000). Aging induces the loss of skeletal muscle mass, strength, power, and function which can lead to reduced quality of life (Hunter et al. 2004; Von Haehling et al. 2010).

Exercise and physical activities, either in a form of endurance or resistance training are well known to have positive impact in preventing, delaying or reversing the frailty process and consequently improve quality of life (Ferrucci et al. 2004). Systematic reviews including meta-analyses have reported that both types of exercise training appear to be the best way to improve walking performance, physical fitness, grip strength, flexibility, balance (Cadore et al. 2013; De Vries et al. 2012; Freiburger et al. 2012) and functional performance in older adults (Hruda et al. 2003; Thomas & Hageman 2003; Witham et al. 2005).

Practising regular exercise and being physically active in daily life are known to correlate positively with improvement in mobility (Nelson et al. 2007). However, the traditional mode of exercise training, which is mostly performed in standing position, is challenging for older adults, especially those with compromised balance and mobility (Villareal et al. 2011). Modification of exercise in older adult is highly recommended to meet their individual

needs (Nelson et al. 2007). Chair-based exercise (CBE), an alternative mode of exercise training which was introduced in the recent years enable older adults to be physically active regardless of their physical abilities (Anthony et al. 2013; Cancela et al. 2017). A recent study in which older adults aged above 80 years were enrolled has introduced three different types of CBE namely aerobic exercise programme, muscular resistance exercise programme and joint mobility programme (Cancela et al. 2017). CBE can be offered in either a residential care or a home setting (Morley et al. 2002) and has also been used on older adults with specific conditions such as dementia (Thomas & Hageman 2003), breast cancer (Headley et al. 2004) and heart failure (Witham et al. 2005). CBE for patients with heart failure has been developed, which contain several exercise levels to enable wider range of intensity to meet the patients' individual needs (Razaob & Doherty 2012). CBE is shown to be feasible and beneficial in reducing fatigue and improving physical well-being among patients with breast cancer (Headley et al. 2004), enhancing daily activity levels among patients with heart failure (Witham et al. 2005), and strength, balance, physical fitness, physical activity and quality of life among older people (Cancela et al. 2017; Durutürk et al. 2016).

Progressive resistance training (PRT) is often used to increase muscle strength (Liu et al. 2011). PRT is a type of strength training in which participants need to exercise their muscle against resistance at a specific set of intensity which is adjusted throughout the training (Christie 2011;

Liu et al. 2011). PRT has been shown to be beneficial in increasing dynamic muscle strength, muscle size, and functional capacity (Mccartney et al. 1995; Steele et al. 2017) as well as wellbeing (Steele et al. 2017) among older adults. Utilizing Thera-band as a resistance device is highly recommended as it is easily available and the training can be continued in home setting instead of using weight machines (Damush & Damush Jr 1999). Low to moderate intensity resistance training is highly recommended for older adults to prevent strength decline (Steib et al. 2010). As such, adding a resistance training component into a CBE program could be beneficial for older adults to further enhance their physical performances. However, there is limited available evidence on CBE with resistance training among older adults, with only one study was found to date. Therefore, the purpose of our study is to evaluate the outcome of CBE with PRT (CBE-PRT) on physical performances among institutionalized older adults.

METHODOLOGY

STUDY DESIGN AND LOCATION

This was a one-group multi-centre experimental study which conducted at three different old folks' home in the Klang Valley in Malaysia.

PARTICIPANTS

Nineteen older adults aged 60 years and above were recruited based on inclusion and exclusion criteria. The inclusion criteria were: (1) able to walk for at least six minutes with or without walking aids and (2) score more than 5 in Elderly Cognitive Assessment Questionnaire (ECAQ). Participants with psychological illness which were identified using Mental Health Screening Form-III (MHSE-III) and chronic unstable medical illness such as uncontrolled hypertension were excluded from this study. Written informed consent was obtained from participants before commencing any test and procedure. This research project was approved by Universiti Kebangsaan Malaysia ethical committee (UKM1.2.3/244/NN-2017-014).

INTERVENTION

The exercise intervention consisted of CBE with inclusion of resistance training (CBE-PRT). The CBE-PRT was performed for two sessions per week for two months. Participants were allocated into different level of CBE based on their functional performance, which was determined on walking test. CBE was demonstrated by playing digital video disc (DVD). CBE program consists of several intensities with involvement of upper limb and lower limb activities with the total duration of the training between 15 to 45 minutes depending on the level. Each CBE includes warm up, main exercise and cool down. CBE with higher intensity involve standing exercise components. Participants who performed

well and able to follow CBE exercises independently were progressed to a higher level CBE.

PRT was conducted in the last part of the CBE in each session. Moderate intensity resistance training with the use of Thera-band was chosen in this study. The PRT was started by using the lowest resistance indicated by the yellow-colored Thera-band and performed for three set of 10 repetition maximum (10-RM). It was then progressed to the next resistance level by using the red-colored Thera-band and eventually green-colored Thera-band. The exercises include bicep curl, triceps extension, chest press, single leg press, hip abduction, knee extension and ankle dorsiflexion and plantarflexion. The progression was depending on a number of factors such as quality of the training. This quality of training includes the number of rate and repetition of resistance training. Resistance training was conducted based on guidelines provided by American College of Sport Medicine (ACSM) for older adults (Nelson et al. 2007).

Vital signs such as blood pressure (BP), heart rate (HR) and oxygen saturation (SPO₂) were monitored before and after exercises in every session.

OUTCOME MEASURES

Three physical performance tests were used as the outcome measures for this study, namely Six minutes walking test, hand grip strength test and five times sit to stand test.

Six Minutes Walking Test (6MWT): 6MWT was used as indicator of aerobic endurance. Participants were required to walk as far as possible in 6 minutes along 15 metres shuttle line that has been marked on the floor. Walking aids were allowed if necessary. Blood pressure (BP), heart rate (HR), oxygen saturation (SPO₂) and Borg Scale were measured at baseline as well as on completion of walking. Instructions and encouragements were standardized for all participants. Total distance was recorded after 6 minutes (Laboratories 2002). 6MWT is easy to administer, sensitive to change after intervention and has high test-retest reliability among older adults in Malaysia (ICC = 0.97) (Razaob et al. 2016).

Hand Grip Strength (HGS): Digital hand dynamometer (Saehan®, Model DHD-1) was used to assess strength of right and left hand. Participant was seated with elbow unsupported and flexed at 90°. Participants were instructed to perform maximum contraction of the hand (squeeze the hand bar) and hold for 4 to 5 seconds and performed the second trial after 60 seconds rest. The highest score of maximum contraction was recorded and used for data analyses (Trampisch et al. 2012). Grip strength is a valid test for prediction of generalized upper body strength among older adults (Bohannon 1998).

Five Times Sit to Stand (FTSTS): FTSTS test was used to measure functional lower limb strength. A standard armless chair (approximately 43 cm high) was used. Participants were instructed to rise from sitting to fully erect position as fast as possible for five repetitions with both

arms cross over the chest. The time required to complete five repeated chair stands was recorded. Two trials were allowed with five-minute rest interval and the average time was calculated and used for data analyses (McCarthy et al. 2004). The test is shown to be reliable and valid in measuring lower limb strength in older adults in Malaysia with ICC 0.98 (Razaob et al. 2016).

STATISTICAL ANALYSIS

All data were analysed using Statistical Package for Social Sciences (SPSS) version 23.0. Paired t-test and Wilcoxon signed rank test were used to compare pre and post outcomes of 6MWT, HGS and FTSTS.

RESULTS

DEMOGRAPHIC DATA, ATTENDANCE AND ATTRITION

Among 19 participants who completed baseline assessments, 1 participant dropped out from the intervention after a few training sessions. The reason for drop-out was moving out of the old folks home to live with son. The remaining 18 participants completed all the 16 sessions of CBT-PRT in 8 weeks and all outcome measurements.

The mean age \pm SD of the participants was 72.67 ± 6.17 (range 60 to 83) years. The characteristics of the participants are shown in Table 1. In the beginning of intervention, the overall distribution of CBE levels was at level 3. Towards the end of intervention, 11 of them progressed to level 4 while another 8 were able to achieve level 5 of CBE. For resistance training, all of the participants started with yellow-colored Thera-band. Progression of training load were observed in 9 participants who progressed to red-colored Thera-band.

TABLE 1. Characteristics of study participants (n = 18)

Variables		N (%)
Gender	Male	5 (27)
	Female	13 (73)
Marital Status	Married	4 (22)
	Single	12 (67)
	Widow/Divorced	2 (11)
Educational level	None	7 (39)
	Primary school	2 (11)
	Secondary school	9 (50)
Medical illness*	None	1 (5.5)
	One disease	2 (11)
	Two disease	12 (67)
	Three disease	3 (16.6)
Walking Ability	Independent	14 (77.7)
	Using walking stick	1 (5.5)
	Using tripod	1 (5.5)
	Using walking frame	2 (11)
Previous exercise practice*	None	7 (39)
	1-2 days/week	5 (27)
	3-4 days/week	3 (16.6)
	5-6 days/week	1 (5.5)
	7 days/week	2 (11)

*Medical illness included hypertension, diabetes, high cholesterol

*Previous exercise practice is mainly brisk walk in the morning

PHYSICAL PERFORMANCES

Table 2 shows a significant improvement in 6MWT ($p < .001$), Right HGS ($p = .043$) and Left HGS ($p < .001$), and reduction in time taken to perform FTSTS ($p < 0.001$) among the participants after 8 weeks of intervention.

TABLE 2. Comparison of 6MWT, HGS and FTSTS at baseline (pre-CBE) and at post-intervention

	Pre – CBE with PRT Mean \pm SD	Post – CBE with PRT Mean \pm SD	<i>p</i>
6 MWT ¹ (m)	212.56 \pm 92.30	272.69 \pm 122.38	< .001
HGS Right Hand ¹ (kg)	13.81 \pm 6.32	16.12 \pm 6.67	0.043
Left Hand ¹ (kg)	12.87 \pm 5.28	16.85 \pm 6.07	<.001
FTSTS ² (s)	Median (IQR) 16.4 (14.55 – 18.88)	Median (IQR) 12.2 (10.08 – 14.75)	<.001

Note: n = 18

¹ = Paired T-test (Mean \pm SD) ² = Wilcoxon rank test (Median (IQR))

DISCUSSIONS

The purpose of this study was to determine the outcome of an eight-week CBE-PRT on physical performances among older adults. Previous studies on the evaluation of health status among older adults reported persistent problem in performing daily living task, and issues in flexibility,

muscle strength and balance (Chen et al. 2012). Therefore, exercise programs which aim at improving these health related conditions are recommended for older adults. Our results showed that CBE program, with inclusion of PRT induced positive effects on older adults' physical performances.

Significant improvement in both right and left hand grip strength was found in older adults in our study. This effect could be due to the exercise intervention which involved upper body exercises in each level of CBE and resistance training. Our finding is consistent with the result of previous study that showed significant improvement in average grip strength after 6 weeks of resistance training (Thomas & Hageman 2003).

Significant reduction in time taken to perform FTSTS indicates improvement in lower limb strength among our study participants. Our results support finding of previous study which reported 22% improvement in lower limb strength after 6 weeks of resistance training (Thomas & Hageman 2003). Another past study which used short duration moderate intensity resistance training also reported similar results at 6 weeks of intervention (Cavani et al. 2002). Improvement in lower limb strength in our participants could result from the nature of training, in which sit-to-stand exercise and resistance training targeting major knee and ankle muscles that influence sit-to-stand performance were included in the program. A past study reported that the performance of sit-to-stand task is largely influenced by the strength of knee extensors, knee flexors, and ankle dorsiflexors (Lord et al. 2002).

Significant improvement in aerobic endurance is also shown among older adults in our study. Contrary to this finding, past studies using CBE as intervention programme reported that there was no significant changes in 6MWT at 6 months of intervention for heart failure population (Witham et al. 2005). Another study which used moderate intensity resistance training for 6 weeks also reported similar result (Cavani et al. 2002). These contradictory findings could be due to the modification of CBE in our study, in which PRT was added into the exercise intervention. Further, our study involved older adults who have no underlying cardiac disease, which may have influenced the training effect. Older adult with heart failure (HF) have been reported to have less capability to respond to training stimulus in terms of skeletal muscle function which could lead to poor functional outcome compared to older adults without cardiac problems (Coats et al. 2017).

Our study intervention differs from other CBE programs (Durutürk et al. 2016; Hruda et al. 2003; Thomas & Hageman 2003; Witham et al. 2005); it consists of comprehensive CBE with different levels of intensity and is not limited to seated exercise only (Razaob & Doherty 2012). By adding PRT training into the CBE, our intervention produces a beneficial effect on physical performances of older adults despite the short intervention period. Our study supports the claim that resistance training using Thera-band is safe, affordable and practical among older adults (Colado & Triplett 2008). There is evidence that low to moderate intensity exercise provides a sufficient threshold for physical performances in older adults (Nelson et al. 2007). Meanwhile, high intensity exercise is claimed to increase the risk of injury and exercise drop out (Evetovich 2009). Our study findings show that moderate intensity

resistance training is adequate to produce positive outcomes despite the fact that our study participants included older adults with chronic medical illness, sedentary lifestyle and functional limitation.

CLINICAL IMPLICATION

It is well documented that the majority of older adults are having a sedentary lifestyle. CBE-PRT program, being feasible and practical, can be recommended as an exercise routine for older adults in view to enhance functional performance as well as to keep them physically active. Health care providers such as physiotherapists may include this training program as part of a comprehensive physical therapy intervention for older adults living in the community.

LIMITATION OF STUDY

Our study findings are subjected to one main limitation. The older adults were recruited from senior citizen residential homes in Klang Valley only and consisted of more females than male participants. Therefore, our findings could not be generalised to the older adults' population in Malaysia. Further study with larger samples and inclusion of older adults from rural areas is warranted to strengthen our study findings.

CONCLUSION

In conclusion, combining PRT into a CBE program produces a positive outcome in the physical performances of older adults. CBE-PRT is therefore recommended as a part of daily living routines for older adults in the community.

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