Original Article

Aerobic training with rhythmic functional movement: Influence on cardiopulmonary function, functional movement and Quality of life in the elderly women

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ABSTRACT

The purpose of this study was to investigate the effects of rhythm of aerobic exercise in elderly women. Thirty subjects were randomly divided into two groups: The aerobic exercise with rhythm (experimental group, n=9) and aerobic exercise without rhythm (control group, n=10). All subjects performed aerobic exercise composed of functional movements. During the exercise, control group subjects were performed the functional movement exercise only to the beat without music or rhythm and experimental group subjects were performed the functional movement exercise to the rhythm of the music. All subjects performed exercise for 50 minutes, twice a week, total of 8 weeks. The forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and maximal voluntary ventilation (MVV) were measured. Functional movements were assessed using FMS (Functional Movement Screen). Quality of life (QOL) were assessed using SF-36. Evaluation was performed before and after 8 weeks of exercise and one month later for follow-up. The FVV, FVC1, MVV, FMS, and SF-36 have shown a significant difference in time as a result of the two-way repeated-measures analysis. The post mean change of FVC1, MVV, FMS, and SF-36 were significantly different between groups. In this study, aerobic exercise, which is composed of rhythmic functional movement, helped improve functional movement and QOL for the elderly women. When the experimental group and the control

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Submitted for publication October 2018
Accepted for publication December 2018
Published *in press* January 2019
JOURNAL OF HUMAN SPORT & EXERCISE ISSN 1988-5202

doi:10.14198/jhse.2019.144.04

group were compared, the improvement of the experimental group with music and rhythm was more positive than the exercise using the same functional movement. **Keywords:** Aerobic exercise; Cardiopulmonary function; Functional movement; Elderly women.

Cite this article as:
Shim, Y.J., Choi, H.S., & Shin, W.S. (2019). Aerobic training with rhythmic functional movement: Influence on cardiopulmonary function, functional movement and Quality of life in the elderly women. *Journal of Human Sport and Exercise*, *in press*. doi:https://doi.org/10.14198/jhse.2019.144.04

INTRODUCTION

Health care for the elderly reduces socio-economic problems (Jin et al., 2015; Read et al., 2016). Physical decline and loss of function due to aging are associated with decreased muscle mass, aerobic capacity, and mobility. As aging progresses, physiologically functional aerobic capacity and physical activity decreased. Abnormal respiratory pattern disorders result in various musculoskeletal disorders and impaired functional movements. Moderate intensity aerobic exercise is recommended to improve cardiovascular health and reduce the risk of coronary artery disease in public health (Myers et al., 2015).

Aerobic exercise programs included walking, jogging, running, swimming, cycling and dancing (Alkatan et al., 2016). Medically supervised aerobic exercise is also very useful for patients with cardiovascular disease, chronic heart failure, chronic obstructive pulmonary disease, and asthma, and has no side effects, and no adverse effects were observed after treadmill intervention in patients with pulmonary hypertension (Chan et al., 2013; Kang et al., 2018; Sin et al., 2015).

Preventive health care is little interest in cardiopulmonary function, which is important for the aerobic exercise and daily life movement. There is little research on the cardiopulmonary function of the elderly without disease, and the function (DeFina et al., 2015; Hwang et al., 2015). Positive effects of physical exercise on improvement of depression and cognitive performance. Music intervention, listening to or playing a musical instrument, has also been shown to improve depression and cognitive function (Yeh et al., 2015). Decreased activity in elderly populations increases the body's asymmetry and functional limitations (Mitchell et al., 2016).

Therefore, this researcher that health management by the therapist is necessary for the prevention of disease in the health of the elderly, especially the cardiopulmonary function which is not well managed by the elderly. Particularly, aerobic exercise can be transformed into various forms, so it can be applied to a large number of elderly people through group exercise. There is a lack of research on aerobic exercise that combine functional movements and music. In this study the effect of rhythmical music combined with functional movements exercise on the cardiopulmonary function, functional movement and quality of life of the elderly.

MATERIAL AND METHODS

Participants

This randomized controlled trial was performed at 2 senior welfare center in Daejeon, Republic of Korea. The power analysis was completed using the G*power program (version 3.1.9.2; Germany). Effect sizes were calculated before subject recruitment using mean and SD from the pilot study that ranged from 0.5. The power was set at 0.8 and number of measurement was set at 3, resulting with a total sample size of 24 patients.

The inclusion criteria of the subjects are as follows. Those who are 65 years of age or older, can walk independently for more than 30 minutes, have no side effects such as dizziness, living in independent daily living activities, and Korean version of the mini-mental status examination (MMSE-K) score of 24 or more. The exclusion criteria of the subject is as follows. Participating in other programs that may affect the results of the study, orthopaedic disorders, suffer from neurological disorders and have problems with balance ability, problems such as vision and hearing. All subjects in research understand their own participation in experimentation. A total of 42 subjects were recruited to this study. A total of 12 participants were excluded from the final outcome because participants (10 subjects) who did not meet the criteria for selecting the subjects and 2 persons who withdrew from the intervention during the intervention were excluded. In this process, only the elderly women were selected as subjects. This study was conducted after the IRB (1040647-201706-HR-033-01), taking into consideration the ethical aspects of all the procedures during the mediation, and proceeding with the written consent with voluntary prior consent.

Measures

To assess cardiopulmonary function was measured using Spirobank-G (MIR, Rome, and Italy). The subject was asked to take a mouthpiece in the sitting position, and to breathe in and out through the mouth using a nose plug. The forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and maximal voluntary ventilation (MVV) were measured (Goel et al., 2015).

The functional movement screen (FMS) is a relatively measurement both for representing various movement factors and for forecasting the general risks regarding musculoskeletal injuries. The seven movement patterns of the FMS are the deep squat, in-line lunge, hurdle step, shoulder mobility, active straight leg raise, trunk stability push-up, and quadruped rotary stability. Each movement of the FMS was scored on a scale of 0–3. A score of three indicated that the movement was performed correctly, a score of two indicated that the movement was done in an ineffective way, and a score of one indicated that the participant could not complete the movement. A score of zero was only given when the participant experienced pain throughout the movement. The maximum score an individual could earn was 21 (Mitchell et al., 2016).

The Short Form 36 (SF-36) Health Survey was used to measure quality of life (QOL). The eight sections are vitality, physical functioning, bodily pain, general health perceptions, physical role functioning, emotional role functioning, social role functioning, and mental health (Han et al., 2004).

Procedure

A total of 30 subjects were randomly assigned to two groups, experimental (n = 9) and control (n = 10). A total of 8 weeks of intervention was conducted twice a week for 50 minutes per session. Both groups performed the same preparatory exercise for the first 10 minutes. The preliminary exercise was performed to stretch neck, shoulder, waist, leg and torso with focus on muscle relaxation to reduce the risk of injury during aerobic exercise intervention.

During the 30 minute exercise, the experimental group performed aerobic exercise by gently connecting the functional movement with music in the form of dance. The control group were performed by moving the functional movement to the beat without music. After 10 minutes of finishing exercise, the two groups performed the same exercise. In addition to stretching the muscles that were tense during the exercise, we applied breathing exercises such as Abdominal Draw-In Manueuver (ADIM) Abdominal muscles and respiratory muscles were also stimulated so that the effect of intervention was maximized.

The two groups of exercises consisted of basic aerobic exercises with the same functional movements. Functional movement configuration and music contents correction is required. The configuration of the functional movement consists of the steps of moving in the left and right and backward directions, rotating in place, projecting, diagonally stretching the upper and lower sides, walking, lunge, side step, and squat.

The experimental group performed rhythmically by connecting the movements with music. The rhythmic training group initially used 8-bit music and later used 16-bit music. In addition, the first week of music was increased by about 10-15 bpm per week in music of about 125 bpm (beats per minute, bpm), and the last week was about 160 bpm. The ratio dynamic training group performed the same functional movements by set for each single action. In this study, three evaluations were conducted. The first evaluation was performed to evaluate the subjects' basic abilities before the intervention, the second evaluation was performed after the intervention of 8 weeks, the last evaluation after one month after all interventions, Respectively. In order to reduce the error of the evaluation, each evaluation item was performed by the therapist of the same person.

Analysis

Descriptive and analytical statistics are presented. The Shapiro–Wilk's test was used to examine for normal distribution of data. Independent t-tests were used to compare significant differences between group means at baseline and change scores, whereas the one-way ANOVA was used to evaluate the change in each measurement pre, post, and follow up in each group. Two-way (group × time) repeated-measures analysis of variance was performed as a within-group factor and a between-group factor. Data were presented as mean and SD.

RESULTS

No significant differences were observed among the 2 groups with regard to age, weight, and MMSE-K ($P > 0.05$). The general characteristics of the subjects are outlined in Table 1.

Table 1. Basic characteristics of participants

Characteristics	Experimental group (n=9)	Control group (n=10)	*P*
Age (years)	75.33 ± 5.31[a]	74.40 ± 3.24	0.646
Height (cm)	150.44 ± 5.68	155.60 ± 4.52	0.056
Weight (kg)	55.11 ± 9.06	59.20 ± 4.49	0.245
MMSE-K(scores)	28.33 ± 1.50	27.60 ± 1.71	0.337

[a] *Means ± SD*

MMSE-K, Korean version of mini-mental state examination.

The change in cardiopulmonary function is as shown in Table 2. The FVV, FVC1 and MVV have shown a significant difference in time as a result of the two-way repeated-measures analysis. There were significant time-by-group interaction in the FVC1 and MVV ($p<0.05$). There were not significant time-by-group interaction in the FVC ($p>0.05$). The pre to post mean change of FVC1 in experimental group was 0.63 ± 0.26 and control group was 0.29 ± 0.47, which was significantly different between group ($p<0.05$). The pre to post mean change of MVV in experimental group was 16.48 ± 5.55 and control group was 8.30 ± 10.41, which was significantly different between group ($p<0.05$).

The change in FMS and SF-36 is as shown in Table 3. The FMS and SF-36 have shown a significant difference in time as a result of the two-way repeated-measures analysis. There were not significant time-by-group interaction in the FMS and SF-36 ($p>0.05$). There were not significant time-by-group interaction in the FVC ($p>0.05$). The pre to post and pre to follow up mean change of FMS was significantly different between group ($p<0.05$). The pre to post mean change of SF-36 in experimental group was 5.11 ± 3.10 and control group was 3.70 ± 1.63, which was significantly different between group ($p<0.05$).

DISCUSSION

The major finding of our study is that functional movement with music to greater recovery of cardiopulmonary function, functional movement and QOL than functional movement without music in female elderly. All two groups of patients showed improvement in FVC, FVC1, MVV, FMS and SF-36.

Table 2. Comparison of mean cardiopulmonary function between two groups

Variables	Experimental group (n=9)	Control group (n=10)	*P*	Time	Time x Group
FVC (L)					
Pre	2.02 ± 0.30 [a]	1.19 ± 0.51	0.502		
Post	2.36 ± 0.54	2.21 ± 0.72	0.496	0.001*	0.104
Follow-up	2.24 ± 0.35	2.19 ± 0.64	0.769		
Pre to post	0.34 ± 0.42	0.29 ± 0.47	0.733		
Pre to follow up	0.22 ± 0.21	0.27 ± 0.34	0.642		
FVC1 (L)					
Pre	1.45 ± 0.29	1.33 ± 0.39	0.359		
Post	2.07 ± 0.24	1.58 ± 0.35	0.001	0.001*	0.001*
Follow-up	1.88 ± 0.31	1.61 ± 0.35	0.033		
Pre to post	0.63 ± 0.24	0.25 ± 0.31	0.001*		
Pre to follow up	0.43 ± 0.23	0.28 ± 0.28	0.116		
MVV (L/min)					
Pre	50.78 ± 10.24	44.76 ± 13.14	0.173		
Post	67.26 ± 7.72	53.06 ± 10.17	0.001	0.001*	0.011*
Follow-up	64.74 ± 10.04	54.31 ± 10.84	0.011		
Pre to post	16.48 ± 5.55	8.30 ± 10.41	0.012*		
Pre to follow up	13.97 ± 7.95	9.55 ± 9.62	0.182		

*[a] Means ± SD, *p<0.05.*
FVC, Forced vital capacity; FVC1, Forced expiratory volume in one second; MVV, maximal voluntary ventilation.

Table 3. Comparison of mean FMS and SF-36 between two groups

Variables	Experimental group (n=9)	Control group (n=10)	*P*	Time	Time x Group
FMS (scores)					
Pre	12.11 ± 2.15 [a]	13.20 ± 1.75	0.247		
Post	15.78 ± 2.49	15.60 ± 1.78	0.859	0.008*	0.062
Follow-up	14.56 ± 2.19	14.11 ± 2.47	0.883		
Pre to post	3.67 ± 2.00	2.40 ± 0.84	0.08*		
Pre to follow up	2.44 ± 1.51	1.50 ± 0.71	0.09*		
SF-36 (scales)					
Pre	19.56 ± 5.55	24.00 ± 6.09	0.116		
Post	28.78 ± 3.46	28.50 ± 4.79	0.888	0.001*	0.051
Follow-up	28.33 ± 4.61	24.40 ± 5.52	0.112		
Pre to post	9.22 ± 3.11	4.50 ± 1.78	0.001*		
Pre to follow up	5.11 ± 3.10	3.70 ± 1.63	0.225		

*[a] Means ± SD, *p<0.05.*
FMS, Functional Movement Screen; SF-36, Short Form 36.

Table 4. Comparison of mean FVC, FEV1 and MVV between two groups

Variables	Experimental group (n=9)	Control group (n=10)	*P*	Interaction *P*
FVC (scores)				
Pre	1.75 ± 0.32[a]	1.94 ± 0.32	0.233	
Post	2.20 ± 0.58	2.05 ± 0.25	0.448	0.030[¥]
Follow-up	2.07 ± 0.53	1.96 ± 0.25	0.535	
P	0.043*	0.436		
Pre to post	0.45 ± 0.40	0.11 ± 0.23	0.037	
Pre to follow up	0.31 ± 0.31	0.02 ± 0.28	0.042	
FEV1 (scores)				
Pre	1.54 ± 0.38	1.54 ± 0.28	0.994	
Post	2.01 ± 0.38	1.87 ± 0.27	0.373	0.054
Follow-up	1.79 ± 0.41	1.76 ± 0.33	0.879	
P	0.041*	0.048*		
Pre to post	0.47 ± 0.15	0.34 ± 0.17	0.082	
Pre to follow up	0.25 ± 0.25	0.22 ± 0.27	0.835	
MVV (L/min)				
Pre	52.04 ± 12.07	51.44 ± 9.62	0.906	
Post	66.91 ± 9.58	56.75 ± 11.41	0.050	0.003[¥]
Follow-up	62.35 ± 12.23	57.48 ± 11.62	0.385	
P	0.031*	0.042*		
Pre to post	14.87 ± 6.19	5.31 ± 5.67	0.003	
Pre to follow up	10.31 ± 7.41	6.04 ± 5.43	0.167	

*[a] Means ± SD, *p<0.05.*

**Significant difference within groups; ¥ Significant difference between groups.*

FVC, Forced vital capacity; FVC1, Forced expiratory volume in one second; MVV, maximal voluntary ventilation.

Age-related physical decline and corresponding loss of functional capacity are often related to the loss of muscle mass, decrease of aerobic capacity, reduced mobility, and other determinants of fitness (Bullo et al., 2015). Aerobic exercise increases muscle mass and affects the whole body, improving physical fitness and cardiorespiratory fitness. In order to achieve the same exercise effect, it is necessary to exercise for a long time, and the boredom and exercise intensity accompanying it are weak, which is ineffective for reaching the target heart rate depending on a person (Franco et al., 2015). Quality of life is affected by physical function, mental function, social function, and mental health (Juenger et al., 2002; Ware Jr & Gandek, 1998). Perform music and dance at low intensity to increase cardiopulmonary endurance, strength, and flexibility, which are important indicators of physical strength. It can be mediated to improve the quality of life by expressing self-efficacy through exercise performance experiences and the physical and psychological stresses of the elderly to interact with the body and mind (Heiberger et al., 2011). An analysis of aerobic exercise with music studies has shown that improved neurocognitive function in healthy elderly and Parkinson Disease (Earhart, 2009; Eyigor et al., 2009; Grocke et al., 2009), including attention, processing speed, executive function, and memory (Brooks & Stark, 1989; Yeh et al., 2015).

The FMS as one of the tools in the assessment of functional fitness for the active elderly population. FMS scores are highly correlated with BMI, age, and activity level. Training in functional movement and rhythm is more effective in FMS scores, which can lower the risk of injury to elderly population (Mitchell et al., 2016). The functional movement with aerobic exercise has restored the aerobic capacity and asymmetry (Eggenberger et al., 2016). In a prior study, which trained upper extremities with music in chronic stroke patients, motor-related assessment of the upper extremity showed greater effectiveness than the control group. Movement music therapy involving repetitive rhythmic movement with a musical instrument, may improve pre-frontal cortex function and cognitive performance (Shimizu et al., 2017). Training in playing music in healthy populations and patients with movement disorders requires resources within motor, sensory, cognitive, and affective systems, and coordination among these systems. The music-supported therapy in chronic stroke on motor, cognitive, and psychosocial functions compared to conventional physical training (Fujioka et al., 2018). The music-based movement program improves physical function and sleep quality in people with multiple sclerosis (Young et al., 2017).

In this study, aerobic exercise, which is composed of rhythmic functional movement, helped improve functional movement and QOL for the elderly women. When the experimental group and the control group were compared, the improvement of the experimental group with music and rhythm was more positive than the exercise using the same functional movement.

ACKNOWLEDGEMENT

This research was supported by the Daejeon University fund (2017).

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