

Effects of Activity in the Wholeness Program on Gait, Balance, and Orthostatic Hypotension of the Demented Elderly

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Background/Objectives: This study has validated the effects on gait and balancing capability and orthostatic hypotension by applying a low and medium intensity wholeness program for fall prevention of elderly dementia patients. **Methods/Statistical analysis:** As the participants in this study, 43 elderly dementia patients, with MMSE-K scores of 15-23 points, aged 70 or older and using day care centres of nursing facilities for senior citizens, were classified into a low intensity group (N = 21) and a medium intensity (N = 17), after which the low and medium intensity wholeness program was conducted for 16 weeks, twice a week, for 60 minutes each time. Gait, balancing capability, and orthostatic hypotension were measured before and after the experiment. **Findings:** And consequently, the application of a low and medium intensity wholeness program for the fall prevention of elderly dementia patients was found to be effective for gait, balancing capability and orthostatic hypotension. **Improvements/Applications:** Therefore, the medium intensity wholeness program was found to be effective in preventing falls in elderly dementia patients.

Key words: *Wholeness program, Demented elderly, Gait, Balance, Orthostatic hypotension.*

Introduction

A fall is an act of falling to a lower position, and when compared to healthy elderly adults, the rate of fall incidence in elderly dementia patients is approximately eight times greater (Allan et al. 2009; Morris et al. 1987). Such increased risks, first, involve a performance dysfunction affecting the gait characteristics such as coordination capability and speed, stride and balance (Beauchet et al. 2008; Delbaere et al., 2012). Secondly, orthostatic

hypotension is a cause of falls, which is one of the important prognostic factors in cognitive declines and increased mortality (Kim, et al.2011). Thirdly, the elderly dementia patients are less likely to participate in regular physical activities, and such physical inactivity would likely cause weakness in the performance of the body, resulting not only in a fall, but also in a risk of hip fractures compared to their peers without dementia (Scandol et al. 2013). However, it has been reported that resistance exercises, walking and balance exercise interventions are effective in preventing falls as well as preventing cognitive delays in the physically weak elderly dementia patients (Hauer, et al. 2012). Therefore, the goal of this study is to clarify the effects of gait, balancing capability, and orthostatic hypotension according to the intensity on fall prevention by applying a low and medium intensity wholeness program constructed considering the characteristics of the elderly dementia patients.

Research Methods

Subjects of Study

As participants in this study, 43 elderly dementia patients aged 70 or older with MMSE-K scores of 15-23 points who used nursing facilities in a senior citizens' day care centre located in Seoul were recruited. Twenty-one of these subjects were assigned to the low intensity group and 17 to the medium intensity group, and on one occasion 3 dropouts and 2 people who did not follow up on the ex-post test were excluded. The wholeness program was conducted at the activity room of the day care centre of the nursing facility for the senior citizens for 60 minutes per day, twice a week, for 16 weeks, under the leadership of one main instructor and two care workers. The research subjects' personal characteristics are provided in Table 1.

Table 1: General characteristics of subjects

Group	Age	MMSE-K	Wholeness Program	Session	Period
LIG	77.2(8.6)	20.3(3.1)	Low-intensity (60min)	32	January 8 to April 25, 2019, twice every week
MIG	75.8(7.8)	19.8(2.4)	Mid-intensity (60min)	32	

Designs for the Wholeness Program

The wholeness program is a professional and systematic brain health integrated cognitive and physical health program targeting the prevention of cognitive degeneration and maintenance of remaining bodily function for elderly dementia patients. In this study, low intensity and medium intensity were applied to the wholeness program considering the characteristics of the elderly dementia patients. As for the intensity, it was set to 40% of low intensity

preliminary oxygen intake (VO₂R), 40% of maximum repetitions (1RM), 60% of medium intensity preliminary oxygen intake (VO₂R), and 60% of maximum repetitions (1RM). Details of the wholeness program are specified in Table 2.

Table 2: Details of the Wholeness Program

Subject	Activity Details	
Expansion of mobility of joints and weight shift and strengthening of anterior muscles (1st-3rd sessions)	Goal	To improve the mobility of shoulder and hip rotations, improve the sense of balance through central movement exercises, and increase the anterior muscle strength in the upright position.
	Process	<ul style="list-style-type: none"> 1 Shoulder rotation muscle relaxation and extension of operating range 1 Balancing according to the shift of the center of the upper body 1 Relaxation of sole via sequential sole movement 1 Hip rotation and extension of operating range in the upright position 1 Strengthening of anterior muscle
Extension of mobility of shoulder rotator muscle and strengthening of quadriceps muscles using Thera band (4th-6th sessions)	Goal	To improve the mobility of the shoulder rotation muscle using a Thera band, and improve the antigravity muscle and quadriceps muscle to prevent falls.
	Process	<ul style="list-style-type: none"> 1 Stimulation of facial muscles 1 Improvement of mobility of shoulder rotation muscle and strengthening of forearm and biceps muscles 1 Thoracic relaxation and strengthening of antigravity muscle 1 Strengthening of core and quadriceps muscles using Thera band
Body enhancement movement and cognitive ability improvement movement using Thera band (7th-9th sessions)	Goal	To improve the flexibility and muscular strength of the upper and lower limbs by using Thera band, and recover cognitive ability via footsteps and finger movements
	Process	<ul style="list-style-type: none"> 1 Upper and lower extremities stretching using Thera band, and muscular strength improvement movement 1 Foot stepping movement using Thera band 1 4 finger movement 1 Upper and lower extremity stretching and muscle strength improvement using Thera band 1 Harnessing the movement of the "High sky and plump horses" saying related to Korean autumn

		1 Complex movement reflecting the “High sky and plump horses” saying
Cognitive complex movement for improving cognitive and physical functions (10th-12th sessions)	Goal	To improve not only physical functions but also cognitive functions by combining cognitive and physical activities.
	Process	1 Upper and lower extremities stretching and muscular strength building movement 1 Moving legs with finger movements 1 Cognitive complex movements combining cognitive activity (game of connecting last word) and movement (physical activity) 1 Cognitive complex movements combining cognitive activity (3, 6, 9 game) and movement (physical activity) 1 Cognitive complex movement combining cognitive activity (counting 1 through 5) and movement (physical activity)
Movement for improving hip muscles and sense of balance (13th-15th sessions)	Goal	To strengthen the hip muscles to stabilize posture during gait and increase the time spent on performance while standing toward improving the body’s sense of balance.
	Process	1 Upper and lower extremities stretching and muscular strength building exercise 1 Harnessing movement to strengthen core muscles 1 Lifting of heel, sole, and toes 1 Standing, lifting of heel, lifting of sole, raising of toes, lifting of knees and balancing
Movement for strengthening hip muscles and posture correction (16th-18th sessions)	Goal	To strengthen the hip muscles to align the bent posture and align upright to perform movement in a stable manner.
	Process	1 Stretching of upper limbs using a ball 1 Harnessing of movement to strengthen core and lower limb muscles 1 Posture correction via breathing and movement 1 Lifting of legs backward, lifting of legs sideways, lifting of sole, tapping of sole, lifting of toes, and balancing
Intensified movement for strengthening hip muscles (19th-21st sessions)	Goal	To strengthen the hip muscles and maintain a stable posture by increasing the time of performing the standing motion and the number of repetitions for the motion.
	Process	1 Stretching of upper limb and movement for strengthening fingertips’ strength 1 Movement for strengthening core and lower limb muscles 1 Lifting of legs backward, lifting of legs sideways, lifting of sole, tapping of heel, lifting of toes, balancing, and down dog while standing upright

Movement for improving sense of balance (22nd-25th sessions)	Goal	To improve the sense of balance not only for stability during gait, but also for improving balance via movements using a gym ball to adjust the body's balance.
	Process	1 Stretching of joints 1 Stretching of upper and lower joints, and the movement of strengthening muscular strength 1 Weight shift in left and right directions (small, large) 1 Rolling of a gym ball using legs
Movement for strengthening core muscles and improving sense of balance (26th-29th sessions)	Goal	To strengthen core muscles in order to stabilize the posture during gait and improve the sense of balance for body strength.
	Process	1 Upper and lower joint stretching and muscular strength strengthening exercise 1 Harnessing of movement for strengthening core muscles 1 Weight shift for improving the sense of balance 1 Balancing using a chair
Movement to improve sense of balance and gait capability (30th-32nd sessions)	Goal	Perform standing movement in a stable manner, work toward balancing during gait, and improve sense of balance and gait capability.
	Process	1 Stretching of upper limb and movement for strengthening fingertip's strength 1 Movement to strengthen core and lower limb muscles 1 Ankle and toe exercises using Thera band 1 Lifting of legs backward, lifting of legs sideways, lifting of sole, tapping of heel, lifting of toes, balancing, and down dog while standing upright

※ Each session finishes with a breathing and stretching routine for muscle relaxation and stability of mind and body.

Measurement

To assess the gait of the elderly dementia patients, G-walk (BTS G-walk®, BTS Bioengineering, Garbagnate Milanes, Italy) was used. G-walk can measure spatio-temporal parameters by using a 3-axis accelerometer, sensor, and a wireless system G-sensor equipped with a 3-axis gyroscope, while allowing for comfortable assessment of gait for 5 minutes by using a belt to attach the wireless G sensor to the waist (L5) area. Such devices do not differ significantly from the generally used Gait analysis equipment (Cho et al. 2014).

To measure the balancing capability of the elderly dementia patients, the Berg Balance Scale (BBS) was used. The Berg Balance Scale consists of 14 items, such as position maintenance,

voluntary postural adjustment, and response to external instability, with each item rated 0 to 4 points for a total of 56 points (Berg et al. 1995).

With regard to the orthostatic hypotension of the elderly dementia patients, the orthostatic disability score was used to measure subjective discomfort in everyday life (Har et al. 1992). This tool consists of items related to whether dizziness is perceived or whether there is trouble with vision during personal hygiene routines in the morning, when shopping, when getting up from a chair and walking, or when eating, and each item is measured on a scale of 0 points for no symptoms, 1 point for minor symptoms, and 2 points if it is difficult to stand or causes trouble in daily life. In this study, only 3 items were measured since it was difficult to measure symptoms during shopping given the characteristics of the elderly dementia patients.

Data Analysis

For the collected data, the mean (M) and standard deviation (SD) were calculated by using the descriptive statistics of all measurements using SPSS/PC+ 18.0. After setting before and after the wholeness program application as independent variables, gait, balance, and orthostatic hypotension were set as dependent variables for the elderly dementia patients. Thereafter, ANOVA was applied and analysed. The significance of the differences between the groups and within the groups concerning the ANOVA results were assessed by conducting an independent t-test and the paired t-test. All statistical significance levels (α) were set to .05.

Results

Group's Homogeneity Test

The subjects of this research consisted of 21 people in the low intensity group and 17 people in the medium intensity group, for a total of 38 people. To validate the homogeneity of the low and medium intensity groups, the independent sample t-test results are provided in Table 3 through Table 5. The two groups of the low and medium intensity groups of this study were found to be homogeneous in terms of gait, balance, and orthostatic hypotension.

Validation of the Effect of Gait Following the Wholeness Program's Intensity

The results of the analysis of the preliminary and post tests of the low and medium intensity groups to examine the effects of the low and medium intensity wholeness program on the gait of the elderly dementia patients are provided in Table 3. In terms of intra-group changes, the medium intensity group score increased significantly from $86.64 \pm .93$ to 94.00 ± 1.27 ex

post ($p < .01$), and the low intensity group score decreased from $87.14 \pm .79$ to 90.52 ± 2.37 ex post, without demonstrating significant differences ($p > .05$). In addition, the difference between the low and medium intensity groups turned out to be significant after 32 sessions of the low and medium intensity wholeness program activities in the intra group changes ($p < .001$). Therefore, it is necessary to expand the medium intensity wholeness program to maintain the gait of the elderly dementia patients.

Table 3: Gait after participation in Wholeness Program

Variable	Group	Pre-Test M(SD)	<i>t</i>	Post-Test M(SD)	<i>t</i>	Change Pre- Post	F
Gait	LIG	87.14(.79)	1.742	90.52(2.37)	-5.418***	-6.102	29.352***
	MIG	86.64(.93)		94.00(1.27)		-21.477	

Validation of the Effect of Balance Following the Wholeness Program's Intensity

The results of the analysis of the preliminary and post tests of the low and medium intensity groups to examine the effects of the low and medium intensity wholeness program on the balance of the elderly dementia patients are provided in Table 4. In terms of intra group changes, the medium intensity group score increased significantly from 43.94 ± 1.24 to 46.11 ± 1.21 ex post ($p < .001$), and the low intensity group score decreased from 43.52 ± 1.28 to 44.33 ± 1.52 ex post without demonstrating significant differences ($p > .05$). In addition, the difference between the low and medium intensity groups turned out to be significant after 32 sessions of low and medium intensity wholeness program activities in the intra group changes ($p < .001$). Therefore, it is necessary to expand the medium intensity wholeness program to maintain the balance of the elderly dementia patients.

Table 4: Balance after participation in Wholeness Program

Variable	Group	Pre-Test M(SD)	<i>t</i>	Post-Test M(SD)	<i>t</i>	Change Pre-Post	F
Balance	LIG	43.52(1.28)	-1.010	44.33(1.52)	-4.005***	-2.318	15.288***
	MIG	43.94(1.24)		46.11(1.21)		-6.299	

Validation of the Effect of Orthostatic Hypotension Following the Wholeness Program's Intensity

The results of the analysis of the preliminary and post tests of the low and medium intensity groups to examine the effects of the low and medium intensity wholeness program on the orthostatic hypotension of the elderly dementia patients are as provided in Table 5. In terms of intra group changes, the medium intensity group score increased significantly from

2.41±.93 to 1.52±.71 ex post ($p < .05$), and the low intensity group score decreased from 2.52±.92 to 2.19±1.07 ex post without demonstrating significant differences ($p > .05$).

However, the difference between the low and medium intensity groups turned out to be significant after 32 sessions of the low and medium intensity wholeness program activities in the intra group changes ($p < .05$). Therefore, it is necessary to expand the medium intensity wholeness program to decrease the orthostatic hypotension of the elderly dementia patients.

Table 5: Orthostatic hypotension after participation in Wholeness Program

Variable	Group	Pre-Test M(SD)	<i>t</i>	Post-Test M(SD)	<i>t</i>	Change Pre-Post	F
Orthostatic hypotension	LIG	2.52(.92)	.368	2.19(1.07)	2.259*	1.919	4.696*
	MIG	2.41(.93)		1.52(.71)		5.222	

Conclusion

This study validated the effects on gait, balancing capability and orthostatic hypotension of a low and medium intensity wholeness program for fall prevention by applying it to a group of elderly dementia patients. As the participants in this study, 43 elderly dementia patients with MMSE-K scores of 15-23 points and who were aged 70 or older and used day care centres of the nursing facilities for the senior citizens were classified into a low intensity group ($N = 21$) and a medium intensity ($N = 17$) group, on which a low and medium intensity wholeness program was conducted for 16 weeks, twice a week, and for 60 minutes each time. Gait, balancing capability, and orthostatic hypotension were measured before and after the experiment, and consequently, the elderly dementia patients' gait, balancing capability and orthostatic hypotension showed significant differences in the interaction by and between the group and implementation, and as a result of the t-tests, significant differences were found in between the implementations. While there was no significant difference in the interactions between the group and implementation in the orthostatic hypotension, the t-test yielded a significant difference between the implementations.

The characteristics of the elderly dementia patients that cause cognitive and physical dysfunctions are complexly interrelated. Considering the long-term nature of dementia, which involves a gradual deterioration with the passage of time, the application of the low and medium intensity wholeness program is determined to be a meaningful activity for positively turning around the symptoms while delaying the complex progression of the elderly dementia patients in the context of being positively effective notwithstanding the passage of time, along with the fact that the declined functionality of the elderly dementia patients has been maintained and managed to the largest extent possible. In particular, implementing the medium intensity wholeness program for fall prevention of elderly



dementia patients is recommended as an intervention activity to secure the optimal effects on gait, balancing capability and orthostatic hypotension within the range of safety.

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