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Brief Communication

Effect of Multicomponent Dual-Task Exercise Program to Gait Performance, Memory and Information Processing Speed in Older Community-Dwellers

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SUMMARY

The present study aimed to clarify whether a multicomponent exercise program could effectively enhance physical and cognitive performances among community-dwellers in a rural area of northern Japan. Community-dwellers aged 60 years or more participated in an exercise program for 90 min/day, once every 2 weeks for 6 months, according to instructions supervised by a trained occupational therapist and a medical doctor specializing in geriatrics. The exercise program consisted of multitask conditions for cognition and physical performance. Physical and cognitive assessments were completed at baseline and after the 6-month intervention. The physical measurements consisted of body mass index, grip strength and usual walking speed, while the cognitive items included memory, attention, executive function and information processing speed. Fifty-eight participants (mean age, 76.2 years; % female, 82.8%) completed the 6-month follow-up period. Statistically, significant improvements in the usual walking speed ($p = 0.0001$), word recognition as memory score ($p < 0.0001$), and information processing speed ($p = 0.02$) were observed after the intervention. Our study suggests that a multicomponent, dual-task exercise program combining physical exercise and cognitive training could be an effective strategy for enhancing physical and cognitive function among older individuals living in rural areas of Japan.

1. Introduction

A multicomponent dual-task exercise program combining physical exercise and cognitive training has been shown to have a significant effect on memory function and gait performance among older adults with a history of falls[1] and on information processing, executive function and memory in cognitively healthy older persons.[2] Similar to these studies, our preliminary study suggested that a multicomponent dual-task exercise program could be an effective strategy for enhancing motor and memory function among older persons living in depopulated rural areas,[3] congruent with an influence on memory following dual-task training.[4,5] Because of the small sample in our previous study, further examinations of the effects of a multicomponent dual-task exercise program, including data from multiple districts in rural areas of Japan, were needed. Therefore, we aimed to clarify whether a multicomponent exercise program could effectively enhance physical and cognitive performances among community-dwellers living in rural areas of northern Japanese, which is becoming a super-aging society.

2. Methods

Eighty-five persons aged 60 years or more were recruited from six areas of Akita city in 2019 using public information available for Akita city. A sample of 101 participants was estimated using the G*Power for t tests for a one-sample group to be capable of detecting a clinical effect with an α value of 0.05, a power of 80%, and an effect size of 0.25. The medical history of each participant was confirmed, but the participants were not classified according to the presence of mild cognitive impairment as indexed using a clinical dementia rating.[6] We performed a 6-month follow-up for the intervention program based on the methodology described by Suzuki (2013).[4] Each participant was asked to perform a 90-min exercise program once every 2 weeks. The program consisted of 10 min of stretching, 20 min of muscle strength exercises, and 60 min of aerobic exercise and a dual-task exercise (e.g., one-leg squats while performing subtractions or a color ladder exercise while performing color recognition). One trained occupational therapist and one medical doctor specializing in geriatrics supervised the program in each of the six areas. Physical and cognitive assessments were obtained at baseline and after the 6-month intervention. The physical measurements consisted of body mass index, the average usual walking speed (UWS) during a 5-m walking test (2 sessions, excluding acceleration/deceleration phases), and grip strength. The word recognition as memory (WR) test, the tablet version of the trail-making test-part A (TMT-A) and part B (TMT-B), and the symbol digit substitution task (SDST) of the National Center for Geriatrics and Gerontology's functional assessment tool,[7] for which the results of a nationwide Japanese survey are available for comparison purposes,

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were used as cognitive assessments. Depending on the instructions given by the therapist and physician, the participants practiced the exercise program continuously throughout the 6 months. The Wilcoxon signed rank test was applied to compare the parameters between the pre- and post-intervention tests. SPSS version 26.0 (SPSS Inc., Chicago, IL) was applied for the statistical analysis, and the significant level was set at p = 0.05. This study was approved by the ethics committee of the Faculty of Medicine at Akita University (approval No. 2236).

3. Results

Among the participants, 58 participants completed the 6-month follow-up examination in 2019 and 27 persons (% dropout, 31.8%) dropped out of the study because of a worsening of their physical condition. Table 1 shows the pre- and post-intervention test results. After the 6-month intervention, significant improvements in the UWS (p = 0.0001), WR (p < 0.0001) and SDST (p = 0.02) were observed.

4.Discussion

We confirmed that both physical performance (UWS) and cognitive function (WR test and information processing speed) improved significantly after the 6-month intervention. Similar to the results of our study, some previous studies have reported that the effects of multicomponent exercise include significant enhancements in gait speed[8] and short-term memory performance,[9] agreeing with the results of our preliminary report examining the effects of a dual-task exercise on motor and memory function.[3] However, the effects of multicomponent dual-task exercises on cognitive function remain controversial, as Bae's study reported an influence of multicomponent exercise on story memory, attention (e.g., TMT-A), and executive function (e.g., TMT-B).[10] Additionally, in a follow-up research sample of 8,699 persons with between the ages of 70 and 74 years, older individuals with a dual decline in both memory and gait speed had a 5.2- to 11.7-times higher risk of developing dementia (pooled hazard ratio, 6.28; 95% confidence interval, 4.56–8.64).[11] The research limitations of the present study should be reconsidered when developing future interventions, including the use of a small sample that did not satisfy the sample-size estimation and the intervention effect inherent to a one-group study. Thus, additional high-quality trials are needed to examine the effects of multicomponent exercise on gait performance and cognitive domains in older community-dwellers.

5. Conclusion

The present study suggested that a multicomponent program combining physical exercise and cognitive training may improve the conditions of older community-dwellers and contribute to the prevention of dementia in the super-aging societies that rural areas of Japan are presently facing.

Conflict of interest

The authors have no conflict of interest to declare.

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Table 1
Result of pre- and post-tests in the participants (N = 58).

	Mean	SD		
Demographic data				
Age (year)	76.2	5.5		
Education (year)	12.4	2.0		
Gender (% female)	82.8%			
Medical history				
Stroke (% Yes)	1.7%			
Parkinson's disease (% Yes)	0%			
Depression (% Yes)	1.7%			
Alzheimer's disease (% Yes)	0%			
	Pre-test	Post-test		
	Median (IQR)	Median (IQR)	z value	p value
Physical item				
BMI (kg/m^2)	23.5 (6.0)	23.6 (5.0)	-0.03	0.98
GS (s)	23.8 (6.5)	24.1 (8.0)	-1.74	0.08
UWS (s)	1.45 (0.3)	1.55 (0.4)	-3.81	0.0001**
Cognitive item				
WR (score)	12.2 (5.2)	13.2 (3.7)	-4.42	< 0.0001***
TMT-A (s)	19.0 (7.0)	19.0 (6.0)	-0.12	0.91
TMT-B (s)	35.0 (22.0)	33.5 (21.0)	-0.12	0.90
SDST (score)	43.5 (14.0)	45.5 (14.0)	-3.10	0.002**

SD, standard deviation; IQR, interquartile range; BMI, body mass index; GS, grip strength; UWS, usual walking speed; WR, word recognition as memory; TMT, trail making test; SDST, symbol digit substitution task.
Table 1 indicated z-value and p-value of the Wilcoxon signed rank test between pre- and post-tests.
** p < 0.01, *** p < 0.001; the Wilcoxon signed rank test.

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