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Research Paper

Continuous participation in a day-care prevention service improves the mobility of the community-dwelling elderly

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Abstract

This study aimed to examine the effect of continuous participation in a day-care fall prevention service on the mobility of the community-dwelling elderly. Peak and mean transfer velocities of the center of gravity (PV and MV, respectively) as well as 10-m maximum walking speed (MWS) were calculated for 57 elderly who participated continuously in a day-care fall prevention service, held 24 times every year for 3 years, between 2010 and 2012 [continuous group (CON), age: 76.0 ± 6.1 years], and 157 elderly who participated in it for only the first year within the same period [dropout group (DO), age: 76.6 ± 6.1 years]. No significant difference was found between PV, MV, and MWS in the first year for the CON and DO ($t > 1.27$, $p < 0.05$). The, PV and MV of the CON increased significantly within a year ($F = 28.1$ and 30.5, $p < 0.05$ in both). Moreover, PV, MV, and MWS of the CON in the third year were significantly higher than those in the DO ($t > 2.55$, $p < 0.05$). Our results suggest that continuous participation in a day-care fall prevention service contributes to an improvement in the mobility of community-dwelling elderly individuals.

Keywords: *Continuity, Nursing Care Prevention Service, Mobility.*

1. Introduction

Falls occur because of a deviation of the center of pressure from the support base, which can be induced by disturbances in motor coordination such as staggering, stumbling, or slipping. Therefore, increasing the capacity for postural control is essential for maintaining/enhancing physical ability and fall prevention.

However, falls can occur when the limits of postural control is greatly exceeded, even in individuals who have adequate physical ability. For example, the physically able elderly, who are at a low risk of falling, but frequently encounter the abovementioned triggers because of being physically able and being active. Such falls can be avoided by improving fall avoidance ability, i.e., by taking a step immediately to expand the support base. This is a very important ability to attain, particularly for the community-dwelling elderly.

Community-dwelling elderly individuals with such capability who live independently can easily undertake activities of daily living (ADL) because they generally have good muscle strength, balance, and gait. These abilities can be evaluated by tests such as the sit-to-stand (STS) test (Bohannon 2011, Fleming et al. 1991, Jones et al. 1999, Lindemann et al. 2003, Nakatani et al. 2004, Nakatani & Ue 2004), the maximum walking speed (MWS) (Bohannon 1997), and the timed up and go test (Podsiadlo & Richardson 1991). Fall avoidance also requires the following abilities: (a) quick perception of the transfer of the center of gravity; (b) agile stepping; (c) adequate stepping without leg entanglement (Yamaji & Demura 2013); and (d) dynamic balance, which refers to postural recovery by swinging the body in the opposite direction to the deviation of the center of gravity from the support base (Dite & Tinple 2002). Therefore, fall avoidance ability is considered to consist of both physical ability and other abilities that make it harder to fall, which can be acquired in individuals with adequate physical ability at baseline.

Services such as day-care fall prevention services have been studied by many local governments using trials, with the aim of maintaining/enhancing physical ability for fall prevention. Various interventions such as exercise classes and fall prevention education have been undertaken. However, in most cases, the required frequency of exercise classes to obtain an effect is usually more than once a week. In such interventions, the elderly attend regular exercise and education classes for fall prevention, with the primary aim of cultivating the habit of going out. Fujita et al. (2006) conducted a follow-up survey of 1,267 community-dwelling elderly individuals to assess the effect of going out regularly on physical function. As a result, they reported that going out is a significant factor for predicting deteriorated or improved physical function in the community-dwelling elderly. Therefore, day-care fall prevention services provided by local governments may encourage the elderly not only to go out but also maintain/enhance their physical ability, making it harder to fall.

This study aimed to examine the effect of continuous participation in a day-care fall prevention service on the peak and mean transfer velocities of the center of gravity (abbreviated as PV and MV, respectively) during the STS test as well as on 10-m MWS.

2. Methods

2.1. Subjects

We included 334 community-dwelling elderly individuals after performing medical checkups to assess their suitability prior to the study commencement. Written informed consent was obtained from all the participants after the purpose and protocol of the study were fully explained. The dropout (DO) group consisted of 157 subjects who did not participate from the second year onward, whereas the continuous (CON) group consisted of 57 who participated continuously for 3 years. Individuals who participated continuously for 2 years but not from the third year onward were excluded from the analysis (Fig. 1). Table1 shows the age and physical characteristics of both the groups. The study protocol was approved by the Ethics Committee on Human Experimentation of the Faculty of Education, Kanazawa University, Japan (authorization number: 19-18).

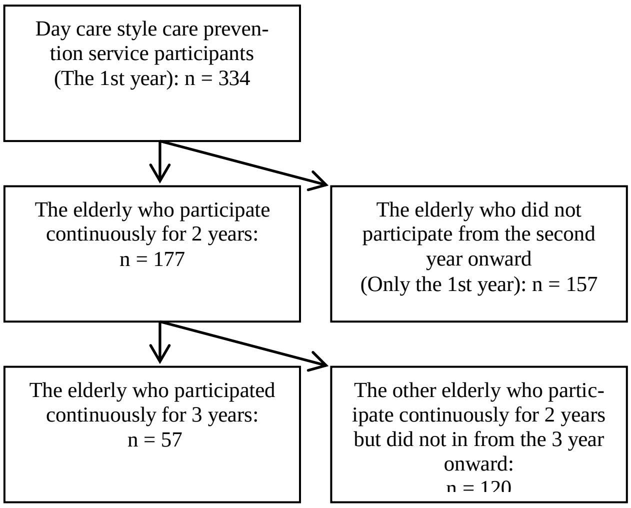

Fig. 1: Changes in Participant Number over the Study Period

2.2. Procedure

To determine the mobility of the participating individuals, they underwent evaluations of PV and MV during the STS test and 10-m MWS. The order in which both tests were performed was counterbalanced, and a sufficient rest period was provided between tests and trials. Both tests were performed twice. In addition, the chair seat height was adjusted according to the knee height of each subject in the STS test.

Table 1: Characteristics of the Study Subjects

	CON		DO		t	*p*	d
	Mean	SD	Mean	SD			
n	57		157				
Age	76	6.1	75.6	6.3	0.4	*0.662*	0.07
Height	149.1	6.3	149.2	7.9	0.1	*0.917*	0.02
Body mass	51	8.4	51.5	9.2	0.3	*0.727*	0.05

2.3. PV and MV during STS test

PV and MV during the STS test was measured according to the method used by Yamada & Demura (2009) Subjects were instructed to adopt the appropriate sitting posture during measurement: they maintained both lower limbs (with bare feet) shoulder-width apart, with the trunk in neutral flexion, ankles at neutral flexion, and arms crossed over the chest. The movements in the STS test were performed as quickly as possible from a sitting position on the instructor's signal. The measurements were obtained using the FiTROdyne Premium (Fitronic sro, Slovakia) device, which can measure the length of a cord pulled from or returned to the bobbin over a given time and incorporates a built-in rotary encoder. Subjects wore a belt at the level of the iliac crest, at which position the cord was fixed to the belt, and the length that the cord moved was measured against time for each STS movement. The center of gravity is located in the abdomen during sitting, but transfers to the lumbar spine and stabilizes it during movement. Therefore, the iliac crest transfer velocity, measured by the distance traveled by the cord against time, is assumed to reflect the transfer velocity of the center of gravity during the STS test. Data were uploaded to a personal computer every 0.01 s.

Table 2: Change in Mobility Over 3 Years in Group Which Participated Continuously in a Day-Care Prevention Service

		1st year	2nd year	3rd year	ANOVA F	*p*	η_p^2	Post-hoc
PV	Mean	95.7	95.6	120.5	28.1	*0.000*	0.33	3>1,2
	SD	22.6	22.4	26.7				
MV	Mean	51.6	51.0	67.4	30.5	*0.000*	0.35	3>1,2
	SD	12.9	13.3	18.2				
MWS	Mean	1.67	1.69	1.72	1.6	*0.211*	0.03	
	SD	0.30	0.30	0.27				

2.4. Ten-meter MWS

The10-m MWS was measured when subjects could walk for 10 m with maximum effort across a flat floor without ramps and obstacles (Bohannon 1997). However, considering the acceleration at the start and deceleration at the end, subjects walked a total of 16 m (10-m evaluation phase between 3 m allowed each at the start and the end).

2.5. Parameters

PV and MV from start to finish were calculated from the time-course data of the transfer velocity of the center of gravity during the STS test (2009). MV during the 10-m phase was calculated from the recorded walking time. In addition, the mean value for both trials was used for analysis in each parameter.

2.6. Parameters

Paired one-way analysis of variance was used to examine the mean differences between the 3 years for the group that participated continuously in a day-care prevention service. The effect size with 3 years' continuance of mean difference was calculated by partial η^2 (η_p^2). Tukey's honestly significant difference was used for post-hoc analysis. An independent t-test was used to examine the mean difference of mobility between the DO group and the CO group and between the first and third years of the CON group. The effect size of the mean difference was calculated by Cohen's d (Cohen 1988). P values of <0.05 indicated statistical significance.

3. Results

Table 1 shows the age and physical characteristics of the CON and DO groups, and no significant difference between the two groups was observed in any aspect. Table 2 shows the mean differences after each year in the CON group. Significant differences were observed in PV and MV during the STS test, with the third year mean being greater than that of the first and second years. Moreover, the effect size (η_p^2) was moderate or above. No significant difference was observed in MWS. Table 3 shows the mean difference in mobility between the CON and DO groups at the end of the first year; no significant differences were observed. Table 4 shows the mean difference in mobility between the third year of the CON group and the first year of the DO group. Significant differences were observed, and all parameters were greater in the CON group than in the DO group. Moreover, the effect size was large in PV and CV during the STS test and moderate in the 10-m MWS.

Table 3: Mean Difference in Mobility between the First Year of the Continuous Group (CON) and Dropout Group (DO)

		CON	DO	t	*p*	d
PV	Mean	95.7	95.6	0.0	*0.995*	0.00
	SD	22.6	31.6			
MV	Mean	51.6	51.5	0.0	*0.968*	0.01
	SD	12.9	19.3			
MWS	Mean	1.67	1.58	1.3	*0.207*	0.20
	SD	0.30	0.37			

Table 4: Mean Difference in Mobility between the Third Year of the Continuous Group (CON) and Dropout Group (DO)

		CON	DO	t	*p*	d
PV	Mean	120.5	95.6	5.3	*0.000*	0.82
	SD	26.7	31.6			
MV	Mean	67.4	51.5	5.4	*0.000*	0.84
	SD	18.2	19.3			
MWS	Mean	1.72	1.58	2.5	*0.012*	0.40
	SD	0.27	0.37			

4. Discussion

Our results show that mobility was identical in both the DO group the CON group after 1 year. Yamada et al. (2013) measured the transfer velocity of the center of gravity during the STS test for community-dwelling elderly individuals who also participated in secondary prevention programs run by the Ministry of Health, Labor, and Welfare in Japan. Their aim was to screen for those elderly individuals with a high likelihood of needing nursing care in the near future, on the basis of the transfer velocity of the center of gravity during the STS test. As a result, they reported that their PV and MV were 97.7 cm/s and 51.9 cm/s, respectively. Moreover, critical levels of these values, at which there was a high likelihood of needing nursing care (cutoff values), were reported to be 84.8 cm/s and 40.1 cm/s, respectively. Meanwhile, Furuna et al. (1995) measured MWS of the elderly living in urban and rural areas, to examine the actual status of the physical ability of the community-dwelling elderly in Japan as well as the difference in physical ability between age groups and genders. As a result, they reported that MWS decreased with age as follows: 1.37 m/s at 65–69 years;1.19 m/s at 70–79 years;1.14 m/s at 75–79 years; and 1.00 m/s at >80 years. MWS in our DO and CON groups were 1.47 m/s and 1.57 m/s, respectively, after 1 year. These values are greater than those reported by Furuna et al. (1995) and Finley & Cody (1970) reported that a minimum of 84 m/min is required to cross a pedestrian crossing safely. From this, it can be concluded that both groups in this study may have higher mobility than the average in the community-dwelling elderly.

Moreover, it is considered that even if the elderly have a relatively high physical function level as stated above, that level is improved after 3 years of continual participation in a day-care fall prevention service, in comparison with those who dropped out. However, the day-care fall prevention service in this study included a focus on classroom lectures, such as nutrition improvement, prevention of cognitive decline, oral health care, and motor function improvement. Furthermore, because the lectures were held twice a month because we considered that to be a relatively low frequency. Fujita et al. (2006) conducted a follow-up survey for 1,267 community-dwelling elderly individuals over 2 years to examine whether frequency of going out can be effectively used as a predictor of alterations in physical function. They reported that the risk of interference of mobility and instrumental ADL was significantly higher in individuals going out once a week or less (OR = 4.02), in comparison with the elderly going out once per day or more; Moreover, the potential to recover was significantly lower in those going out less frequently (OR = 0.29). In addition, Shimada et al. (2010) surveyed ADL status, life-space assessment, and frequency of going out over the 4 weeks before the study in 1,872 community-dwelling elderly individuals, to examine the relationship between the frequency of going out and disability-related functional decline. They reported that it is necessary for them to go out of their house at least once a week to maintain physical functions. Therefore, the frequency of the day-care fall prevention service in this study would not contribute to an increase in the frequency of going out, thus ruling out an unintentional improvement of mobility in the CON group. However, participation in the service may have contributed to triggering an increase in the frequency of going out. Some of the other factors related to improvement in physical function are as follows: forming new friendships with the participants, increasing the opportunities to go out with the other participants outside the service, and understanding the importance of going out and exercising as a result of the service, and increasing the frequency of going out beyond attending the service. Physical function improvement with continual participation could be the result of a combination of these factors. This should be examined in more detail in future studies.

It should also be noted that the number of individuals who continued with the day-care fall prevention service for 3 years totaled 57 out of 334 (17.1%), whereas around half of them (47.0%) dropped out after the first year. The distance between the location of the day-care fall prevention service and participants' homes was relatively small, because the service was provided in a small community. Therefore, many participants visited the service on foot or by bicycle. It has been inferred that many elderly individuals cannot increase their opportunity of going out despite the limited range of their ADL. Hirai and Kondou (2007) reviewed a wide range of literature to clarify the conclusion that the tendency of staying indoors among elderly is a risk factor for needing nursing care. They reported that the range of ADL, the frequency of going out, the alteration in current status, and mobility are closely related to the tendency of the elderly to stay indoors. Although the factors associated with the elderly staying indoors were not surveyed in the DO group in our study, their risk of needing nursing care is inferred to be, or tended to be, higher in this group than in the CON group. Therefore, a care prevention service that takes the above factors into consideration may be strongly required.

5. Conclusion

Participating continuously in a day-care fall prevention service contributes to the improvement in the mobility of the community-dwelling elderly. However, future studies need to be conducted to examine the cause–effect relationship between such improvement and continuous participation.

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