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The effectiveness of group Otago exercise program on physical function in nursing home residents older than 65 years: A randomized controlled trial

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ABSTRACT

Aim: To examine whether the 6-months group-based Otago exercise program is more effective than usual care on physical function and functional independence in nursing home residents older than 65 years.

Methods: An observer-blind randomized controlled study included 77 independently walking, cognitively unimpaired residents aged 78.4 ± 7.6 years, of which 66.2% were female. Physical function was assessed at baseline, after 3 and 6 months of the Otago exercise program by three performance tests: Berg Balance Scale (BBS), Timed Up and Go (TUG) and Chair Rising Test (CRT), and functional independence by the motor Functional Independence Measure (mFIM).

Results: Significant within participant effects of time in EG for BBS, TUG and CRT ($p < 0.001$) and for mFIM ($p = 0.010$) were found. Between participant effects of groups on BBS, TUG, CRT and mFIM values were not significant. Changes in values of performed three tests regarding physical function were significantly different in EG and CG ($p < 0.001$), as well as for functional independence test (mFIM) ($p = 0.019$). In EG the values got better, while in CG values worsened. Effect sizes of change in the EG were higher for BBS, TUG and CRT compared to mFIM.

Conclusion: The Otago exercise program was shown as effective in improving balance, functional mobility, lower limbs muscle strength and functional independence, indicating that it could help in slowing of disability progression.

1. Introduction

It is expected that the number of institutionalized older people will increase in the future (Bastone & Jacob, 2004) thus the actions for the improvement of their functionality are needed. Age related decline in physical functionality seems to be more pronounced in institutionalized than in community-dwelling older people (Marshall & Berg, 2010). Aging process results in significant decrease in muscle mass and strength (Auyeung, Lee, Leung, Kwok, & Woo, 2014; Benavent-Caballer, Rosado-Calatayud, Segura-Ortí, Amer-Cuenca, & Lisón, 2016; Farinatti et al., 2013; Hassan et al., 2016; Senior, Henwood, Beller, Mitchell, & Keogh, 2015) and in impaired balance (Howe, Rochester, Neil, Skelton, & Ballinger, 2011; Sherrington et al., 2008). This leads to reduced walking speed (Keogh, Senior, Beller, & Henwood, 2015) and physical function (Farinatti et al., 2013; Howe et al., 2011), and subsequently to a loss of independence in transfers and walking, which is particularly pronounced in institutionalized older people (Bautmans, Van Hees, Lemper, & Mets, 2005). The prevalence of a loss of skeletal muscle mass, strength and function, termed sarcopenia, is very high in older people living in nursing homes (Hassan et al., 2016; Keogh, Senior, Beller, & Henwood, 2015; Senior, Henwood, Beller, Mitchell, & Keogh, 2015).

Exercises are considered to be the main intervention method in improving balance, muscle strength and mobility (Benavent-Caballer

Abbreviations: OEP, Otago exercise program; EG, experimental group; CG, control group; CIRSG, Cumulative Illness Rating Scale for Geriatrics; SI, severity index; BBS, Berg Balance Scale; TUG, Timed Up and Go test; CRT, Chair Rising Test; mFIM, motor Functional Independence Measure; ADL, activities of daily living

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et al., 2016; Fien, Henwood, Climstein, & Keogh, 2016; Freiberger, Häberle, Spirduso, & Zijlstra, 2012; Gschwind et al., 2013; Hassan et al., 2016; Sherrington et al., 2008). Multimodal exercise programs that include strengthening, balance and aerobic exercises represent the best strategy to improve physical function (Bautmans, Van Hees, Lemper, & Mets, 2005; Benavent-Caballer et al., 2016; Cadore, Rodríguez-Mañas, Sinclair, & Izquierdo, 2013). Despite the wealth of evidence in literature supporting the value of exercise in community-dwelling older people, the role of group exercise in the institutionalized older people so far was rarely examined (Marshall & Berg, 2010). In several studies effects of different exercise programs on physical function in the institutionalized older people were investigated (Cadore et al., 2014; Fien et al., 2016; Hassan et al., 2016; Kovács et al., 2012; Lazowski et al., 1999; Rugelj, 2010). It should be beard in mind that study feasibility in ideal research setting is often not so easy to accomplish in nursing homes due to the numerous subjective and objective parameters (comorbidity, willingness, motivation, relocation, etc.) that might influence the feasibility size. Therefore, when study is planned all factors should be taken into consideration. However, the size of feasibility of resistance exercise program was previously analyzed in the study of Fien et al., where authors noticed that this exercise program was feasible and safe in about 25% of nursing home residents (Fien et al., 2016).

Home-based "Otago exercise program" (OEP), that incorporates balance and strengthening exercises and walking has been proven as effective in community dwelling older people, but only in a few studies it was investigated as group-based OEP (Benavent-Caballer et al., 2016; Kyrdalen, Moen, Røysland, & Helbostad, 2014). To our knowledge the OEP so far has not been investigated in nursing homes. Hence, this study aimed to examine whether the 6-months group-based OEP is more effective than usual care on physical function and functional independence in the nursing home residents aged 65 years and older.

2. Methods

2.1. Study design and participants

An observer-blind randomized controlled 6-months prospective study was conducted in a nursing home, from October 2016 to April 2017. Physical function and functional independence measurements were carried out at baseline prior to randomization (T_0), after 3 months (T_1) and 6 months (T_2) of exercise program. The time window from T_0 to the beginning of the exercise sessions was up to 7 days.

The residents of this institution aged 65 years and older who can walk independently without a walking aid or use a cane only for long walks were recruited. The exclusion criteria were: refusal to participate in the study, blindness, acute or terminal illnesses and severe chronic diseases restricting ability to participate in exercise sessions, lower extremity fracture during the last year, cognitive impairment (Mini-Mental State Examination score < 24) (Folstein, Folstein, & McHugh, 1975) and usage of medications affecting balance. After applying the inclusion and exclusion criteria 77 elderly participants were eligible for the study.

After the baseline assessments participants were randomly allocated to the experimental group (EG) or to the control group (CG) using computer-generated random numbers. The random allocation sequence was generated by a person independent from the research group. The researchers doing functional assessments were blinded to participant's group allocation. Group allocations were only revealed to two physiotherapists who conducted the exercises sessions. Participants were instructed not to discuss their randomized allocation with researchers. Participants were given written informed consent to participate in the study. The study was approved by the Institutional ethics committee.

2.2. Exercise program

Participants from EG were enrolled in 6-months training sessions according to the OEP. The OEP is an individually tailored, home-based, strength and balance training program designed to prevent falls of older people (Otago Medical School, 2003). This program consists of strengthening and balance exercises that progress through four levels of difficulty. Each training session started with 5–7 min gentle warm-up exercises and continued with about 30–35 min of strength and balance training. At the end of each session the participants were instructed to walk 5–7 min at their usual pace in order to cool down. Additionally, they were included for walks at least twice a week for 30 min at a moderate pace, on days without assigned exercise program.

The exercise program was adjusted to the participants' physical fitness. The number of repetitions, the level of resistance and the difficulty of balance exercises were increased gradually according to the changes of participants' abilities through the course of the training. Ankle cuff weights from 0.5–5 kg were used to provide resistance.

Each exercise session was carried out in group settings of up to ten participants under the supervision of two experienced physiotherapists. One of physiotherapists demonstrated exercises and breathing technique during exercising, while the other one was present for the participants' safety and correcting of each exercise. Sessions were conducted three times a week on non-consecutive days, at the same time before noon.

The participants were instructed to inform a physiotherapist immediately in case they experience any form of distress. Participants' attendance and adverse events occurrence at each session were recorded. Participants allocated to the CG were advised to continue with standard care and activities.

2.3. Assessments

2.3.1. Baseline assessment

The data about sex, age, educational level, marital status, history of falling in the past year, number of regular medications and comorbidity were collected through face-to-face interviews and medical records. Then, the participants body height (without shoes) and weight (in light clothes, in the morning before meal and water intake) measures were taken, and body mass index was calculated.

To estimate the comorbidity of participants, the Cumulative Illness Rating Scale for Geriatrics (CIRSG) was used (Firat, Bousamra, Gore, & Byhardt, 2002). The results were presented as the severity index (SI), that was calculated as the total CIRSG score divided by the number of endorsed categories. Comorbidity estimation was carried out by a board certified rehabilitation medicine specialist (Kocic et al., 2016).

2.3.2. Physical function measurements

The participants underwent three physical performance tests for assessment of balance, functional mobility and lower extremities strength. The examiner first demonstrated each task. Between these assessments, the participants were given a 15-min rest. Each participant was assessed by the same researcher at the same time of the day (after breakfast). The results of the previous assessments were blinded from the researchers who performed the following assessments.

For balance assessment, the Berg Balance Scale (BBS) was used (Berg, Wood-Dauphinee, & Williams, 1995). It evaluates 14 tasks (5 static and 9 dynamic) that are related to stability in sitting, standing, standing up, turning around, walking on an even surface, walking on steps and balance while changing body position. The BBS has been found to be excellent, internally consistent and to have a high degree relative inter-rater reliability in a population of nursing home residents (Telenius, Engedal, & Bergland, 2015).

Functional mobility was evaluated using the Timed Up and Go test (TUG) (Podsiadlo & Richardson, 1991). The TUG involves rising from a chair, walking 3 m, turning around, walking back to the chair and sitting down. The participants were instructed to complete the task at their usual pace. The time is taken when the participants rise from an armchair until they sit down again.

Muscle strength of lower limbs was assessed indirectly by the Chair Rising Test (CRT) (Guralnik et al., 1994). A standard chair with no arms and a seat height of approximately 43 cm was used. The participants were asked to fold their arms across their chest and to stand up and from the chair. If successful, participants were asked to stand up and sit down five times as quickly as possible. They were timed from the initial sitting position to the final standing position at the end of the fifth stand.

TUG and CRT were carried out twice with a 5-min rest between each trial. The shorter of the times measured in the two trials was recorded for each test.

2.3.3. Functional independence measurement

For evaluation of the level of the participant's functional independence, motor Functional Independence Measure (mFIM) was used (Hamilton & Granger, 1994). It measures the degree of independence on a sample of 13 items of activities of daily living (ADL) divided into four areas: self-care activities, sphincter control, transfers and locomotion. Each item is graded from 1 (complete dependence) to 7 (complete independence). Functional ability was observed and scored by a trained nurse.

2.4. Statistical analysis

Statistical analyses were performed using PASW Statistics for Windows in version 18.0 (SPSS Inc, Chicago, IL, USA). Continuous variables are given as means ± SD (standard deviation) and (medians). Categorical variables are given as absolute numbers (N) and in percentages (%). Statistical significance was defined as a $p < 0.05$.

Independent sample *t*-tests or Man-Whitney test (depending on data distribution normality for continuous variables) and chi-square tests were used to assess for group differences at baseline.

The effects of exercise program on performed tests of physical function and functional independence over time was assessed by Analyses of Variance for Repeated Measures (RM ANOVA).

3. Results

3.1. Baseline characteristics

The flow of participants through to the study is presented in Fig. 1. Out of the 77 participants who started the study, 88.3% completed the 3-month assessments and 77.9% completed the 6-month assessments. The baseline characteristics of the participants are presented in Table 1. The mean age of study participants at baseline was 78.4 ± 7.6 years (range: 65–90) and the most participants were female (66.2%). There were no significant differences in any of the baseline characteristics between the EG and the CG. The participants in the EG and CG who dropped out of the study did not differ from the participants who completed the study in any of the baseline variables except for the mFIM score in EG ($p = 0.028$) (Table 2).

3.2. Adherence and exercises adverse events

The participants in the EG adhered to 92.7% of 78 training sessions through 6 months (mean 72 out of 78 sessions).

No major adverse event, fall or health problem related to the exercise program was reported. One participant in the EG reported low back pain because of which he stopped exercising for two weeks and continued afterwards. During the first weeks 7 participants in the EG reported fatigue and muscle soreness caused by exercises, which disappeared eventually.

3.3. Effects of Otago exercise program on physical function and functional independence

Mean values with SD and median for performed tests: BBS, TUG, CRT and mFIM, were presented in Table 3.

Effects of Otago exercise program on physical function and functional independence tests values are shown in Table 4. There was significant within participant effects of time in EG for three physical function tests (BBS, TUG and CRT) ($p < 0.001$) and for functional independence test (mFIM) ($p = 0.010$). Further we found significant within participant effects of time in CG for CRT ($p = 0.028$). Thus in CG values got worsened, opposite to the EG, where values got better (Tables 3 and 4).

Between participant effects of groups on physical function tests values (BBS, TUG and CRT) and functional independence test (mFIM) value were not significant. Changes in values of performed three tests regarding physical function were significantly different in EG and CG ($p < 0.001$), as well as for functional independence test ($p = 0.019$). In EG the values got better, while in CG values worsened (Tables 3 and 4).

Effect sizes of change in the EG were higher for BBS, TUG and CRT compared to mFIM (Table 4).

4. Discussion

The effectiveness of the 6-months group-based OEP on physical function and functional independence was investigated in older residents of the nursing home. The OEP consists of strengthening and balance exercises, that are simple to follow and requires only simple equipment, a chair and ankle weights, and can be performed in groups of up-to 10 participants under supervision of qualified physiotherapist, demonstrating feasibility of this program in nursing homes. Within-group analysis showed significant improvements in EG over 6 months of OEP for balance, functional mobility and lower limb muscle strength assessed by the BBS, TUG and CRT tests. Also significant improvement in level of functional independence assessed by the mFIM in the EG was noted over 6 months.

However, the between groups analysis reported no significant differences for BBS, TUG, CRT and mFIM values, but changes in values of performed tests were significantly different in EG and CG (values in EG got better, while values in CG worsened).

The OEP has been shown to be an effective strategy in prevention of functional decline of community-dwelling older people, while there is insufficient evidence to reach conclusions which exercises program is most appropriate for long-term care residents (Crocker et al., 2013). We achieved a total exercise dose of at least 50 h and frequency of exercise of 3 times a week, as suggested as necessary to improve functional performance (Freiberger, Häberle, Spirduso, & Zijlstra, 2012; Nakamura, Tanaka, Yabushita, Sakai, & Shigematsu, 2007). In the EG an improvement of 2 s in the TUG and 5 points in the BBS were obtained, which is more than suggested as the minimum clinically important difference for those tests (Clegg, Barber, Young, Iliffe, & Forster, 2013; Donoghue et al., 2009).

The OEP as a group training was investigated in a few studies (Benavent-Caballer et al., 2016; Kyrdalen, Moen, Røysland, & Helbostad, 2014). Consistent with our results, Benavent-Caballer et al. (2016) reported significant within group improvements for BBS, TUG and CRT over 4 months of video-supported group-based OE Kyrdalen et al. (2014) compared effectiveness of 3 months of the OEP as group versus home training pointing out significant improvement in both groups in the BBS and TUG but the results were significantly better for both BBS and TUG in group-based than in home-based OEP. The comparison of our findings with the results of above mentioned studies is limited due to the fact that these studies were conducted among community dwelling older people.

In several studies the role of different group exercise programs in

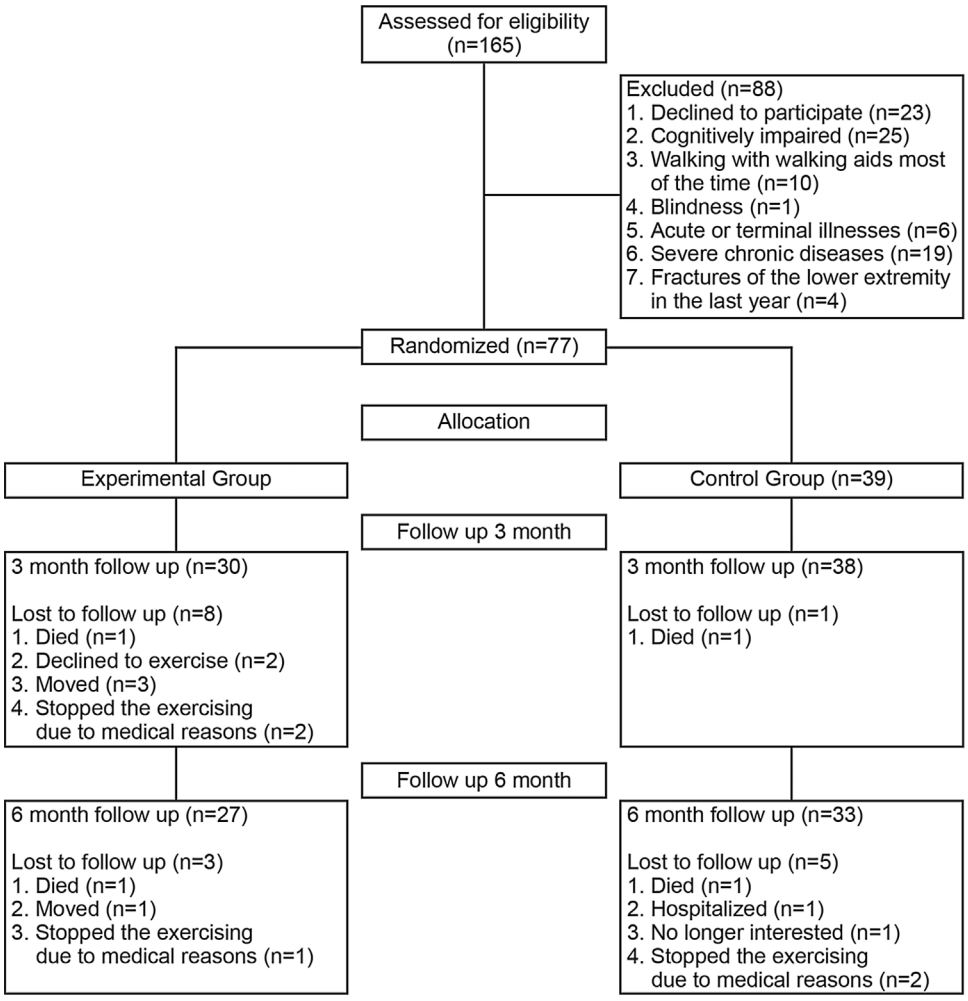

Fig. 1. Flow chart.

the institutionalized older people was investigated (Cadore et al., 2014; Fien et al., 2016; Hassan et al., 2016; Kovács et al., 2012; Lazowski et al., 1999; Rugelj, 2010) but none of them investigated the OEP. Novelty of our study is investigations of the OEP in nursing home residents. Similarly, to our findings, Lazowski et al. (1999) pointed-out significant differences in results of both BBS and TUG tests comparing the effects of a 4 months multimodal exercise program with an exercise program including only flexibility exercises. Also, 12 weeks of

Table 1
Baseline demographic and clinical characteristics of participants.

		EG (n = 38)		CG (n = 39)		*p*-value
Sex	Male	10	(26.3%)	16	(41.0%)	0.175
	Female	28	(73.7%)	23	(59.0%)	
Marital status	Widower	26	(68.4%)	25	(64.1%)	0.171
	Divorced	9	(23.7%)	9	(23.1%)	
	Single	3	(7.9%)	1	(2.5%)	
	Married	0	(0.0%)	4	(10.3%)	
Education	Primary	15	(39.5%)	21	(53.9%)	0.309
	Secondary	17	(44.7%)	11	(28.2%)	
	High/university	6	(15.8%)	7	(17.9%)	
Age		78.3 ± 8.1 (79.5)		78.5 ± 7.2 (79.0)		0.967
BMI		25.9 ± 5.1 (25.8)		23.7 ± 4.4 (22.6)		0.051
Numbers of falls		1.4 ± 1.8 (1.0)		0.8 ± 1.2 (0.0)		0.093
SI		2.0 ± 0.4 (2.0)		1.9 ± 0.3 (2.0)		0.507
MMSE (0–30)		29.1 ± 1.2 (30.0)		29.0 ± 1.4 (30.0)		0.887
Number of medications		4.0 ± 1.6 (4.0)		4.1 ± 2.1 (4.0)		0.702
BBS (0–56)		42.7 ± 8.4 (45.0)		46.2 ± 6.7 (46.0)		0.109
TUG (seconds)		18.9 ± 6.9 (17.1)		17.8 ± 5.9 (16.0)		0.511
CRT (seconds)		12.0 ± 2.6 (12.0)		11.7 ± 4.1 (11.2)		0.273
mFIM (13–91)		85.9 ± 5.9 (88.0)		87.4 ± 5.8 (89.0)		0.330

Continues variables are given as means ± SD (medians) and categorical variables as absolute number – n and in percentages (%). EG, Experimental group; CG, Control group; BMI, Body Mass Index; SI, Severity Index; MMSE, Mini Mental State Examination; BBS, Berg Balance Scale; TUG, Timed Up and Go; CRT, Chair Raising Test; mFIM, motor Functional Independence Measure. A shorter time (seconds) represents a better performance. A higher score represents a better outcome.

Table 2
Baseline characteristics of participants who completed the study versus participants who dropped out.

	EG (n = 38)					CG (n = 39)				
	Completed the study (n = 27)		Dropped out of the study (n = 11)		*p*-value	Completed the study (n = 33)		Dropped out of the study (n = 6)		*p*-value
Sex										
Male	5	18.5%	5	45.5%	0.116	13	39.4%	3	50.0%	0.674
Female	22	81.5%	6	54.5%		20	60.6%	3	50.0%	
Marital status										
Widower	19	70.4%	7	63.6%	0.921	20	60.6%	5	83.3%	0.695
Divorced	6	22.2%	3	27.3%		8	24.2%	1	16.7%	
Single	2	7.4%	1	9.1%		1	3.0%	0	0.0%	
Married	0	0.0%	0	0.0%		4	12.1%	0	0.0%	
Education										
Primary	12	44.4%	3	27.3%	0.391	20	60.6%	1	16.7%	0.062
Secondary	12	44.4%	5	45.4%		7	21.2%	4	66.7%	
High/university	3	11.1%	3	27.3%		6	18.2%	1	16.7%	
Age	77.5 ± 6.9 (79.0)		80.5 ± 10.5 (85.0)		0.164	78.7 ± 7.3 (79.0)		77.3 ± 7.2 (78.5)		0.675
BMI	26.4 ± 5.1 (25.7)		24.7 ± 5.1 (25.8)		0.351	23.9 ± 4.6 (23.4)		22.9 ± 2.4 (22.2)		0.538
Number of falls	0.8 ± 1.2 (0.0)		0.5 ± 0.6 (0.5)		0.748	1.4 ± 1.7 (1.0)		1.4 ± 2.0 (1.0)		0.948
SI	2.0 ± 0.4 (2.0)		2.0 ± 0.3 (2.00)		0.705	1.9 ± 0.3 (2.0)		2.0 ± 0.3 (2.0)		0.402
MMSE (0–30)	29.2 ± 1.1 (30.0)		28.8 ± 1.4 (30.0)		0.517	28.9 ± 1.4 (30.0)		29.7 ± 0.8 (39.0)		0.182
Number of medications	4.0 ± 1.7 (4.0)		3.9 ± 1.2 (4.0)		0.824	4.1 ± 2.2 (5.0)		3.7 ± 1.4 (4.0)		0.431
BBS (0–56)	43.4 ± 7.0 (45.0)		41.0 ± 11.5 (44.0)		0.735	46.1 ± 6.5 (46.0)		47.0 ± 8.1 (47.5)		0.845
TUG (seconds)	19.0 ± 7.5 (17.4)		18.8 ± 5.6 (16.7)		0.859	18.1 ± 6.2 (16.0)		16.4 ± 3.2 (16.6)		0.924
CRT (seconds)	11.6 ± 2.3 (12.0)		13.0 ± 3.1 (13.0)		0.227	11.7 ± 4.4 (12.0)		11.6 ± 1.5 (11.8)		0.917
mFIM (13–91)	87.4 ± 4.7 (90.0)		82.2 ± 7.1 (82.0)		**0.028**	87.3 ± 5.4 (89.0)		88.0 ± 4.7 (91.0)		0,471

Continues variables are given as means ± SD (medians) and categorical variables as absolute number − n and in percentages (%). EG, Experimental group; CG, Control group; BMI, Body Mass Index; SI, Severity Index; MMSE, Mini Mental State Examination; BBS, Berg Balance Scale; TUG, Timed Up and Go; CRT, Chair Raising Test; mFIM, motor Functional Independence Measure. A shorter time (seconds) represents a better performance. A higher score represents a better outcome.

Table 3
Physical function and functional independence at baseline, 3 and 6 months after exercise program.

	Assessment time		
	T_0	T_1	T_2
BBS (0–56)			
EG	42.7 ± 8.4 (45.0)	47.0 ± 6.7 (48.0)	48.0 ± 6.6 (49.0)
CG	46.2 ± 6.7 (46.0)	46.4 ± 6.8 (46.0)	45.6 ± 6.7 (46.0)
TUG (seconds)			
EG	18.9 ± 6.9 (17.1)	17.2 ± 7.1 (15.4)	16.2 ± 7.5 (13.9)
CG	17.8 ± 5.9 (16.0)	17.9 ± 6.2 (16.3)	19.1 ± 6.8 (17.3)
CRT (seconds)			
EG	12.0 ± 2.6 (12.0)	10.7 ± 2.5 (11.0)	9.5 ± 2.1 (10.0)
CG	11.7 ± 4.1 (11.2)	11.6 ± 4.7 (11.0)	12.7 ± 4.1 (12.1)
mFIM (13–91)			
EG	85.9 ± 5.9 (88.0)	87.9 ± 4.1 (90.0)	88.0 ± 4.0 (90.0)
CG	87.43 ± 5.3 (89.0)	87.1 ± 5.5 (89.0)	86.7 ± 5.7 (89.0)

Continues variables are given as means ± SD (medians). T_0, before intervention; T_1, 3 months after intervention; T_2, 6 months after intervention. EG, Experimental group; CG, Control group; BBS, Berg Balance Scale; TUG, Timed Up and Go; CRT, Chair Raising Test; mFIM, motor Functional Independence Measure. A shorter time (seconds) represents a better performance. A higher score represents a better outcome.

Table 4
Effects of exercise program on physical function and functional independence.

	Within participant effects			Between participant effects	Interaction group × time
	All participants	EG	CG		
BBS (0–56)					
p value	< **0.001**	< **0.001**	0.160	0.937	< **0.001**
Effect size[a]	0.574	0.892	0.059		
TUG (seconds)					
p value	**0.004**	< **0.001**	0.055	0.560	< **0.001**
Effect size[a]	0.114	0.720	0.103		
CRT (seconds)					
p value	**0.021**	< **0.001**	**0.027**	0.084	< **0.001**
Effect size[a]	0.065	0.635	0.107		
mFIM (13–91)					
p value	< **0.001**	**0.010**	0.147	0.574	**0.019**
Effect size[a]	0.951	0.227	0.065		

EG, Experimental group; CG, Control group; BBS, Berg Balance Scale; TUG, Timed Up and Go; CRT, Chair Raising Test; mFIM, motor Functional Independence Measure. A shorter time (seconds) represents a better performance. A higher score represents a better outcome.

[a] Partial eta squared (ηp^2).

progressive functional exercise program performed five times a week resulted in a significant improvement in the BBS compared to a non-exercised CG (Rugelj, 2010), while 12 weeks of multicomponent exercises program performed in nonagenarians twice a week resulted in significant improvement in the TUG (Cadore et al., 2014).

Level of a functional disability was investigated in institutionalized older people in several studies (Cadore et al., 2014; Kovács et al., 2012; Lazowski et al., 1999; Rugelj, 2010) but in only one study it was assessed by the FIM (Lazowski et al., 1999). Lazowski et al. (1999) reported that there were not significant differences in the FIM score after 4 months of the exercise program within-group or between-groups while in our study significant differences were found within-groups regarding the mFIM score. Disability was more frequently measured by the Barthel Index (BI) but none of the studies found significant improvement in the BI after exercise program (Cadore et al., 2014; Kovács et al., 2012; Rugelj, 2010). Cadore et al. (2014) reported BI deterioration in both the EG and CG, which can be attributed to the fact that their study included very old people with mean age of 92 years. A very high baseline BI score in study of Kovács et al. (2012) could be an explanation for the lack of improvement.

Similar to our results, in the institutionalized older people Fien et al., found significant improvement in the 30 s sit to stand test after 12 weeks of group resistance exercise program (Fien et al., 2016). The authors also noticed significant improvement in gait speed and handgrip strength. However, in contrast to our study their participants had reduced strength of lower limbs, since at the baseline assessment none

of them being able to stand up from the chair with their arms across the chest. All study participants in our investigation were able to perform such test, and average values for CRT performance was 12 s. The possible explanation for such discrepancy was due to the fact that our study participants were younger by average of 8.6 years, had normal cognitive function and were able to walk independently without walking aids, except for 3 participants that used cane only for long walks. In contrast to our study, Fien et al., reported that 55% of participants used walking aids, and 40% of them had some degree of cognitive impairment (Fien et al., 2016).

Further, Fien et al., stressed out that certain programs of group exercises are feasible and safe in nursing homes leading to the functional improvement (Fien et al., 2016). Similarly, Hassan et al., pointed out that combined resistance and balance training lead to the improvement in muscle strength in very old nursing home residents (Hassan et al., 2016).

There are several strengths and limitations to this study. Data obtained from only one nursing home and a relatively small sample size being main limitations of this study. Secondly, the drop-out rate was high in the EG. Additionally, our study recruit participants who were independent in walking, implying that the results cannot be generalized to overall residents of nursing home. Moreover, we did not follow exercise-induced improvements over a longer period of time.

The main strength of the present study was that physical performance tests were assessed by two of the researchers who had been a board certified rehabilitation medicine specialists for more than 10 years, enabling uniform criteria of data collection. Another strength is that exercises were performed under supervision of two physiotherapists who encouraged the participants progression. Also, the overall exercise sessions attendance rate was very high over 6 months (93%). Furthermore, there were no major but only a few minor adverse events, probably because of satisfied adjustment of the exercises to the participants' ability and the gradual progression of training.

In our study recruitment rate of initially eligible participants of 46%, very high attendance rate of 93% and no major adverse event suggest on acceptable feasibility of OEP in nursing homes residents able of independent walking, despite the fact that drop-out rate was slightly higher (29%). It should be underlined that 4 patients from EG moved to another city and thus were unable to complete study program. Therefore, only 7 (18%) patients dropped-out due to the medical reasons or unwillingness to complete study program.

Our study included 26% of entire nursing home residence, that is in accordance with the study of Fien et al., where investigators noticed inclusion of about 25% of the facility population (Fien et al., 2016).

5. Conclusions

This study demonstrated that the group-based OEP combining strengthening and balance exercises was safe and feasible for nursing home residents with very high adherence. Our results could suggest that this program might be effective in improving balance, functional mobility, lower limbs muscle strength as well as level of functional independence in nursing home residents older than 65 years. Achieved physical functioning improvements could help in disability progression slowing of an institutionalized older people.

In view of the growing institutionalization of an older population, further larger clinical studies are needed to evaluate the effectiveness of the group-based OEP in slowing of physical function decline, for the purpose of future implementation of this program in nursing homes.

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Conflict of interest

The authors declare no conflict of interest.

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