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Effects of Individually Tailored Physical and Daily Activities in Nursing Home Residents on Activities of Daily Living, Physical Performance and Physical Activity Level: A Randomized Controlled Trial

Helena Grönstedt[a] Kerstin Frändin[a] Astrid Bergland[c] Jorunn L. Helbostad[d] Randi Granbo[d] Lis Puggaard[e] Mette Andresen[f] Karin Hellström[b]

[a]Department of Neurobiology, Care Sciences and Society, Karolinska Institutet, Stockholm, and [b]Department of Neuroscience, Uppsala University, Uppsala, Sweden; [c]Faculty of Health Science, Oslo and Akershus University College, Oslo, and [d]Department of Neuroscience, Norwegian University of Science and Technology, and Department of Clinical Services, St. Olav University Hospital, Trondheim, Norway; [e]University of Southern Denmark, Odense, and [f]University College Sjaelland, Naestved, Denmark

Key Words
Frail elderly · Nursing homes · Physical activities · Physical function · Nordic countries

Abstract
Background: Nursing home residents are extremely inactive and deterioration in health and an increasing dependence in activities of daily living (ADL) are common. Physical activity and exercise play a major role in the preservation of physical function and quality of life late in life. However, evidence for the benefit of rehabilitation in nursing home residents is conflicting and inconclusive. ***Objective:*** To evaluate the effect of an individually tailored intervention program of 3 months, for nursing home residents, on ADL, balance, physical activity level, mobility and muscle strength. ***Methods:*** In this single-blind randomized clinical trial with parallel groups, nursing home residents >64 years of age from three Nordic countries were included. The intervention group (IG) was assigned to individually tailored physical and daily activities, while the control group (CG) received ordinary care. Primary outcomes were ADL and balance, and secondary outcomes physical activity level, mobility and muscle strength. ***Results:*** At baseline, 322 nursing home residents were included, of whom 266 were assessed after 3 months of intervention. Following the intervention, a significant difference was found between participants in the IG and CG on measures of balance, physical activity and transfers. The CG significantly improved walking/wheelchair speed and functional leg muscle strength. The CG had significantly deteriorated in ADL, balance and transfers. Persons who had taken part in the intervention for more than 150 min/week significantly improved their balance and physical activity level. Participation in more than 10 weeks of intervention significantly improved physical activity and walking/wheelchair speed, while a deterioration was seen in those who had participated less. ***Conclusion:*** Individually tailored intervention in nursing home residents focusing on physical and daily activities is effective in improving transfers, balance and physical activity level compared to usual care. The effect of the intervention is dependent on the total activity time.

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Helena Grönstedt, MSc, RPT
Division of Physiotherapy, Department of Neurobiology, Care Sciences and Society
Karolinska Institutet, 231 00
SE–141 83 Huddinge (Sweden)
E-Mail helena.gronstedt@ki.se

Introduction

As a consequence of the increasing number of older people in the years to come, the demand for long-term residential care will increase [1]. When an older person has moved to a nursing home, a deterioration in health and an increasing dependence in activities of daily living (ADL), for example walking and dressing, is often seen [1]. A study by Cress et al. [2] showed that residents in nursing homes take on average 3,000 steps less per day compared to community dwellers. Nursing home residents are extremely inactive and MacRae et al. [3] demonstrated that up to 94% spent their time sitting or lying down, in spite of the fact that they were capable of ambulation without human assistance.

Previous studies have shown that physical activity and exercise play a major role in the preservation of physical function and quality of life late in life [4, 5]. According to the recommendations for older adults, developed by the American College of Sports Medicine and the American Heart Association, a minimum of 30 min of moderate-intensity physical activity for 5 days a week is recommended. In addition, training of muscle strength, flexibility and balance as well as management of fall risk should be included [6]. Physical performance, especially walking speed, chair rise and balance, is strongly associated with the ability to perform ADL and risk of injury from falls [7]. Fear of falling and avoidance due to fear of falling are common in older people, both in fallers and non-fallers [8]. This underlies the need to identify those fearful and avoidant older persons in order to facilitate recommendations of intervention strategies.

Evidence for the benefit of rehabilitation in nursing home residents is conflicting and inconclusive. A recent randomized controlled trial (RCT) concluded that 3 months of physical and occupational therapy had no significant effect on mobility and independence in ADL [9]. An RCT by Serra-Rexach et al. [10] demonstrated increased muscle strength and reduction in falls in ambulatory nursing home residents aged 90 and older. However, they failed to show any effects on functional performance assessed as grip strength, walking ability, stair climbing and mobility. In contrast, in three systematic reviews [1, 11, 12] evidence was found showing that physical training had positive effects on mobility, physical functioning and cognition in institutionalized older patients. A Cochrane study [1] concluded that physical rehabilitation in long-term care residents is worthwhile and safe, that it reduces disability and leads to few adverse events such as pain, chest pain or loss of balance. Most trials have reported improvement in physical functioning. However, there is insufficient evidence to make recommendations about content of the intervention, or to draw any conclusions about the long-term effect and cost-effectiveness. In addition, it is not clear whether the training should be given in groups or individually for best effects [1].

In order to prevent unnecessary functional decline, the importance of individually tailored intervention programs is emphasized by several authors [5, 13]. The older and more physically and mentally frail the participant is, the greater the need for individually tailored exercise programs developed and supervised by a trained specialist [4]. However, in Nordic nursing homes, services such as physiotherapy and occupational therapy are limited. We wanted to focus on the frailest residents, who are dependent in ADL and seldom get involved in specific training. In addition, balance is strongly associated with ADL and mobility [7].

The aim of this study was to describe the effect of individually tailored physical and daily activities in nursing home residents on ADL assessed with the Functional Independence Measure (FIM a–m) [14] and balance assessed with the Berg Balance Scale (BBS) [15]. A secondary aim was to describe the effect on physical activity level, mobility, muscle strength and fall-related self-efficacy. Our hypothesis was that 3 months of individually tailored physical and daily activities for this target group will preserve function, while only receiving usual care will reduce function.

Methods

Design and Sample

The study was a multi-center RCT with a parallel group design, and followed the CONSORT statement criteria for reporting clinical trials [16]. Nursing home residents in Sweden (Stockholm and Uppsala), Norway (Oslo and Trondheim) and Denmark (Zealand) were recruited and randomized to either an intervention group (IG) or a control group (CG). Inclusion criteria were as follows: (1) age over 64 years (becoming 65 the same year); (2) having physical disability, defined as need of daily assistance in a minimum of one personal ADL (P-ADL), and (3) expected stay in the nursing home during the study period. Residents at a terminal stage of disease were excluded. Twenty-four nursing homes (4 Swedish, 9 Norwegian and 11 Danish) in the three countries were represented. Thirty percent of the invited residents declined to participate. Reasons for non-participation were mostly based on the residents' own perception that they were too old for getting any results from training. Baseline data were collected from 322 residents, 85 from Sweden, 171 from Norway and 66 from Denmark. Of these, 266 were eligible for the 3-month follow-up tests (fig. 1). The study design has been fully described in a previous article [17]. The project was approved by the ethics committees at all participating centers.

Intervention

The IG was assigned to individually tailored physical and daily activities, while the CG only received ordinary care and treatment. A team comprising one physiotherapist (PT) and one occupational therapist (OT) was responsible for the intervention at each location. When a resident was included in the IG, clinical assessments were carried out by PT and OT respectively, and an individual treatment goal was set in cooperation with the participant. The participants were asked to list important and specific activities that they were unable or had difficulties to perform. The goals were then discussed with reference to importance [18] and an individual training program was designed and then weekly revised to gradually increase the intensity and make the training progressive. The programs consisted of physical and daily activities in different combinations, depending on the goals and on the physical and cognitive function of each participant. Individual supervised physical training such as transfers, walking, balance, strength and endurance training was offered, as well as various group activities such as outdoor walks and gymnastics with the PT present to assist participants. Supervised training was also given in personal care, dressing and eating. Social activities based on each participant's interests took place individually or in groups and could consist of creative and/or entertaining activities such as art, music, gardening, or cooking with the OT present to assist participants. In addition, all participants were stimulated to be as physically active as possible in all daily activities. To incorporate the intervention into the resident's daily life, all staff members at the unit were informed about each participant's treatment goals and also offered personal supervision focusing on the participant's specific needs regarding transfers, ADL and other activities related to independence during the day [17].

The intervention was divided into five main categories: training to decrease *activity limitations* such as walking or rising from a chair, training to decrease *functional impairments* such as muscle strength or balance function, *instructions* for self-administered training, *provision and adjustment of technical aids* (i.e. walking aids) and *guidance of staff*. The PTs and OTs responsible for the intervention recorded the total number of minutes each participant spent on each category of intervention. Due to loss of data, this documentation was completed only at four centers and includes 117 participants.

Baseline Characteristics

Data regarding gender, age, length of stay in the nursing home, number of diagnoses and drugs were obtained from medical records. Information about ability to walk and ability to rise from a chair was derived from assessments. A short question regarding fear of falling (response alternatives yes or no) was also included [19] as fear of falling has a strong relation to avoidance of activities (i.e. making especially older persons more sedentary) [20]. The question was posed only at four of the centers (n = 228) as one failed to include it. Cognitive function was assessed by the Mini-Mental State Examination (MMSE), a brief test that quantitatively assesses the severity of cognitive impairments and documents cognitive change over time. It ranges from 0 to 30, where a high score indicates good cognitive function [21]. A score <24 is considered as a cut-off score for dementia [21]. The test has shown satisfactory reliability [22].

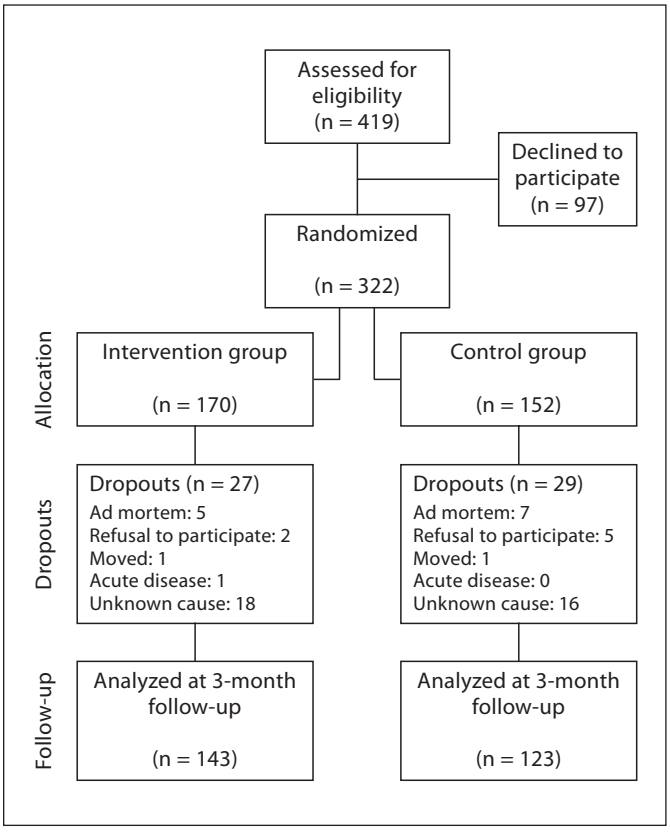

Fig. 1. Flow chart of participants through the trial.

Primary Outcomes

ADL was assessed with the FIM (items a–m) [14]. FIM describes residents' performance according to a 7-grade scale, where grade 1 means total assistance and grade 7 full independence. The instrument consists of 18 items, of which 13 address physical function and 5 social and cognitive functions. The sum score ranges from 12 to 91 points. Both reliability and validity have been found to be good [23]. In the present study, the nursing home staff, primarily the person working closest to the resident, graded the residents' performance according to FIM and the subscale that addresses physical function (items a–m) was used for analysis.

Functional balance was assessed by the BBS [15]. The scale consists of 14 tasks of relevance to everyday life. Scoring is based on the ability to perform items independently and to meet certain time or distance requirements. Each item is scored on a 0–4 Lickert scale, with 56 as the best possible score. The scale has been shown to possess very good intra- and inter-rater reliability and acceptable validity [24].

Secondary Outcomes

Physical activity level was assessed with the Nursing Home Life Space Diameter (NHLSD) [25]. The scale describes the extent and frequency of physical activity during the previous 2 weeks according to a 6-grade scale, ranging from 0 (never) to 5 (>3 times a day), regarding how often the participant moves

around in a certain area and whether the activity is performed independently (1) or dependently (0). The NHLSD is divided into two subscales: 'semi total' (maximum 50 points), which addresses the area and frequency of activity, and 'total' (maximum 100 points), which also includes information about the need of assistance. Higher points on the scale indicate a higher physical activity level.

Mobility was assessed by 10 m indoors walking or wheelchair propulsion at self-selected and maximum speed (m/s) [26]. The Physiotherapy Clinical Outcome Variables (COVS) was used to assess ability to transfer [27].

Grip strength was measured with a Jamar hand-held dynamometer (Sammons Preston) [28, 29] and *functional leg muscle strength* with the Timed Chair Stand test [30].

Fall-related self-efficacy was assessed with the Falls Efficacy Scale Swedish version (FES (S)) [31].

Sample Size

Based on a power analysis assuming a power of 80% of α of 0.05, and a dropout rate of 10%, it was determined that a number of 216 participants (108 in each study arm) would be sufficient to detect a difference between groups in ADL. In order to detect a mean difference of 3 points [32] between groups for the BBS, 155 participants were needed in each study arm (n = 310) using a power of 80% and an α value of 0.05.

Randomization

Ward staff identified eligible participants according to the inclusion criteria and invited residents to participate. After the baseline assessment participants were categorized into either independent or dependent on personal assistance in mobility (i.e. walking or wheelchair propulsion). Dependence in mobility and gender were then used as stratification variables. At each center, participants in each nursing home ward were randomized to IG or CG, using a random sample list provided by a statistical adviser [17].

Procedure

Informed consent was obtained from all participants or, when the participant was diagnosed with dementia, from significant others. Research PTs or OTs, employed particularly for the study, assessed all participants at baseline (T1) and immediately after the end of the 3-month intervention period (T2). In order to secure high inter-tester reliability, the assessors were trained in the test procedures before the start of the study.

Blinding

Assessors were blinded to the group assignment and not involved in the intervention.

Statistical Analysis

Descriptive statistics were used for computing frequencies, central tendency and variability. The Kolmogorov-Smirnov test was used to check for normal distribution. Mean change is presented as the difference (positive or negative) between the participant's baseline value and the value at the 3-month follow-up for each measurement. For normally distributed variables (10 m walking/wheelchair propulsion and grip strength), differences between groups in change over time as well as changes within groups was assessed by independent and paired samples t tests respectively. For non-parametric comparisons, the Mann-Whitney U test was used for analyses of differences in change between groups and the Wilcoxon's signed-rank test for analysis of changes within groups. The results of grip strength are based on data from Sweden and Norway. Since grip strength was measured with a Colin dynamometer in Denmark, a comparison between the three countries was not possible to carry out. The level of significance was set to $p \leq 0.05$. Statistical analysis was performed with the SPSS program version 20.

Missing data were imputed with the individual's mean values regarding interval data or median values regarding ordinal data and have been described in detail in a previous article [33].

Intention-to-treat analysis (ITT) of changes over time between groups and change within groups was done by last value carried forward.

Results

A total of 322 participants were included, 266 of whom were also assessed at the 3-month follow-up, meaning that 29 participants in the CG and 27 in the IG were lost to follow-up. Five participants in the IG and 7 in the CG died during the 3-month period (fig. 1). There were no statistical differences regarding group characteristics at baseline (table 1). Mean age was 85 years, mean length of stay just above 2 years and 73.5% were females. Three out of 4 could walk with or without aids, 47–58% were afraid of falling and about 60% could rise from a chair. The median MMSE score was 19 in both groups, which indicates dementia [21].

Between-Group Differences in ADL, Physical Performance and Physical Activity Level

Following intervention, a significant difference was found between groups regarding balance ($p = 0.001$), physical activity ($p = 0.038$) and transfers ($p = 0.024$), where the IG had improved while the CG deteriorated. There was no significant group difference in mean change for ADL ($p = 0.293$). The ITT analysis did not change the results (table 2).

Within-Group Differences in ADL, Physical Performance and Physical Activity Level

The IG improved significantly in walking/wheelchair speed (self-selected $p = 0.038$, maximum $p = 0.003$) and functional leg muscle strength ($p = 0.019$), while the results for ADL and balance were maintained during the intervention period. The CG significantly deteriorated in ADL ($p = 0.012$), balance ($p = 0.004$) and transfers ($p = 0.023$). The ITT analysis did not change the results (table 3).

Table 1. Study group characteristics at baseline

Variable	Intervention group (n = 170)	Sample size	Control group (n = 152)	Sample size	p
Age, years	85 ± 7.74	170	84.9 ± 7.60		0.83[a]
Female sex	122 (71)	170	115 (76)	161	0.43[b]
Length of stay, months	25 ± 30.31	161	24.41 ± 32.03	139	0.75[a]
MMSE	19 (0–30)	161	19 (0–30)	144	0.76[b]
Able to walk	107 (71)	150	98 (75)	130	0.45[b]
Able to rise from a chair	104 (62)	167	89 (59)	150	0.59[b]
Afraid of falling	68 (58)	117	52 (47)	111	0.09[b]
Number of diagnoses	2.98 ± 1.68	130	2.7 ± 1.54	112	0.53[a]
Number of drugs	6.17 ± 3.12	111	6.56 ± 3.79	99	0.06[a]

Values are mean ± SD, n (%) or median (min–max). [a] Independent samples t test. [b] Mann-Whitney U test.

Table 2. Change between groups after the intervention period according to per-protocol and ITT analyses

Variables[a]	Mean change IG (total n = 143)		Mean change CG total (n = 123)		p[b]	ITT mean change IG		ITT mean change CG		p[b]
	mean ± SD	n	mean ± SD	n		mean ± SD	n	mean ± SD	n	
FIM a–m	–0.7 ± 8.2	136	–2.02 ± 11.2	121	0.293[c]	–0.56 ± 7.5	163	–1.64 ± 10.1	149	0.264[c]
BBS	0.6 ± 8.3	128	–2.37 ± 7.9	111	0.001[c]	0.48 ± 7.5	159	–1.84 ± 7.0	143	0.001[d]
NHLSD semi total	0.77 ± 10.3	111	–1.75 ± 10.2	101	0.038[c]	0.55 ± 8.7	154	–1.34 ± 8.9	132	0.029[d]
NHLSD total	0.49 ± 15.2	105	–0.8 ± 16.3	97	0.316[c]	0.33 ± 12.6	153	–0.59 ± 14.0	132	0.247[c]
10 m self-selected speed, m/s	0.36 ± 0.18	97	–0.01 ± 0.14	80	0.529[d]	0.03 ± 0.15	126	–0.01 ± 0.12	113	0.183[d]
10 m maximum speed, m/s	0.07 ± 0.22	87	0.032 ± 0.25	64	0.580[d]	0 ± 0.2	115	0 ± 0.28	101	0.947[d]
COVS	0.37 ± 8.1	123	–1.73 ± 7.0	105	0.024[c]	0.36 ± 7.3	150	–1.35 ± 6.0	141	0.012[c]
Grip strength[e], kg										
Dominant hand	0.7 ± 4.3	107	0.008 ± 4.5	91	0.712[d]	0.6 ± 3.8	130	0.006 ± 3.9	120	0.253[d]
Non-dominant hand	0.17 ± 4.5	101	0.39 ± 4.3	88	0.946[d]	0.14 ± 4.1	124	0.28 ± 3.8	114	0.728[d]
Timed chair stand test, s	–5.16 ± 25.4	58	–2.17 ± 29.9	41	0.323[c]	–3.8 ± 21.9	78	–1.35 ± 23.5	66	0.097[c]
FES(S) total	0.1 ± 32.3	78	–1.86 ± 33.3	76	0.924[c]	0.07 ± 26.5	115	–1.26 ± 27.3	112	0.810[c]

NHLSD semi total = Extension of physical activity; NHLSD total = extension and dependency in physical activity.

[a] A high score on FIM or COVS indicates a high degree of independence in ADL. A high score on the BBS indicates a better balance function. A high score on the NHLSD indicates a high physical activity level and more independence in mobility. A high score on FES(S) indicates a high degree of fall-related self-efficacy. [b] Level of significance ≤0.05. [c] Mann-Whitney U test. [d] Independent samples t test. [e] Denmark excluded.

Compliance

Sixty-eight percent (n = 118) completed 10–13 weeks of intervention and with a mean dosage of intervention of 117 min/week (SD 81.13). The most common reasons for not completing the whole intervention period were illness, acute hospital admission or unwillingness to continue to participate in the study. Fifty-three percent of the interventions focused on decreasing activity limitations (transfers, standing, walking, personal care, individual activity). Functional impairments (range of motion, balance/coordination, strength, dexterity) comprised 32.2% of the interventions, instructions for self-administered training 0.7%, technical aids 2.7%, guidance of staff 2.1% and other activities 9.8%.

At the 3-month follow-up, participants who had taken part in 150 min or more of intervention/week had sig-

Table 3. Change within groups after the intervention period according to per-protocol and ITT analyses

Variables[a]	IG (n = 143)							CG (n = 123)						
	T1	T2	n	p[b]	ITT T2	n	p[b]	T1	T2	n	p[b]	ITT T2	n	p[b]
FIM a–m	48 (13–90)	48 (13–90)	136	0.837[c]	48 (13–91)	164	0.832[c]	47 (13–91)	42 (13–91)	121	0.012[c]	42 (13–91)	149	0.012[c]
BBS	18 (0–56)	18 (0–55)	128	0.055[c]	16 (0–55)	163	0.055[c]	21 (0–54)	17 (0–51)	11	0.004[c]	13.5 (0–51)	146	0.004[c]
NHLSD semi total	22 (4–50)	25 (0–50)	111	0.578[c]	22 (0–50)	164	0.578[c]	22 (0–50)	22 (0–46)	101	0.082[c]	22 (0–46)	142	0.082[c]
NHLSD total	34 (5–100)	36 (0–100)	105	0.431[c]	33 (0–100)	164	0.431[c]	37 (0–100)	33 (0–92)	97	0.524[c]	30 (0–92)	141	0.524[c]
10 m self-selected speed, m/s	0.45 ± 0.22	0.49 ± 0.27	97	0.038[d]	0.47 ± 0.35	137	0.036[d]	0.45 ± 0.2	0.43 ± 0.24	80	0.475[d]	0.42 ± 0.24	119	0.494[d]
10 m maximum speed, m/s	0.63 ± 0.29	0.71 ± 0.34	87	0.003[d]	0.63 ± 0.05–2.5	129	0.003[d]	0.64 ± 0.3	0.67 ± 0.38	64	0.449[d]	0.53 ± 0.06–2.0	111	0.442[d]
COVS	58 (15–91)	63 (15–91)	123	0.358[c]	59 (15–91)	151	0.356[c]	60 (13–91)	58 (17–91)	105	0.023[c]	59 (17–91)	141	0.021[c]
Grip strength[e], kg														
Dominant hand	14.4 ± 9.8	15.3 ± 10.6	107	0.059[d]	14.7 ± 9.7	131	0.064[d]	13.6 ± 8.0	13.4 ± 8.2	91	0.727[d]	13.1 ± 8.0	123	0.710[d]
Non-dominant hand	13.1 ± 8.3	13.4 ± 8.5	101	0.537[d]	12.6 ± 8.4	127	0.529[d]	11.4 ± 7.6	11.7 ± 7.6	88	0.434[d]	11.3 ± 7.5	119	0.435[d]
Timed chair stand test, s	29 (8–219)	26 (6–151)	58	0.019[c]	28 (8–187)	86	0.017[c]	28 (8–187)	27.2 (10–138)	41	0.795[c]	27 (10–138)	72	0.894[c]
FES(S) total	81 (0–130)	75 (0–130)	78	0.615[c]	71 (0–130)	91	0.615[c]	71 (0–130)	78.5 (0–130)	76	0.372[c]	73.5 (0–130)	120	0.377[c]

Data are expressed as median (min–max) or mean ± SD. NHLSD semi total = Extension of physical activity; NHLSD total = extension and dependency in physical activity.
[a] A high score on FIM or COVS indicates a high degree of independence in ADL. A high score on the BBS indicates a better balance function. A high score on the NHLSD indicates a high physical activity level and more independence in mobility. A high score on FES(S) indicates a high degree of fall-related self-efficacy. [b] Level of significance ≤0.05. [c] Wilcoxon signed-rank test. [d] Paired samples t test. [e] Denmark excluded.

nificantly better balance (p = 0.003), higher transfer scores (p = 0.046) and were more physically active (p = 0.005) than the others. When controlling for baseline characteristics, those who had taken part in more than 150 min of intervention/week had a shorter length of stay (p = 0.035), fewer diagnoses (0.001), fewer prescribed drugs (p = 0.001) and to a lesser extent were afraid of falling (p = 0.053) compared to others. However, there were no significant differences in baseline characteristics between those who had reached the 10 weeks of intervention and those who had not. Those who had participated in more than 10 weeks of intervention significantly improved, and the others deteriorated, in physical activity (p = 0.05) and maximal walking/wheelchair speed (p = 0.05). Table 4 shows variables that were affected by duration (<10 and ≥10 weeks) and amount (<150 and ≥150 min/week) of intervention.

No major adverse events associated with the prescribed exercises and activities were observed.

Discussion

The main, novel finding of the present RCT was that an exercise intervention (12 weeks) with special emphasis on individually tailored exercise programs led to significant specific gains in physical activity level in nursing home residents. Furthermore, training-induced gains were also demonstrated in balance and transfers. The IG showed an improvement in walking/wheelchair speed and leg muscle strength after 12 weeks of intensified training, while the CG deteriorated in ADL, balance and transfers during the same period.

Our hypothesis was confirmed for balance but not for ADL. However, regarding transfers, an improvement was demonstrated, and being able to transfer is actually a part of ADL. While FIM mainly describes what a person actually and spontaneously does, COVS assesses his/her functional capacity, and our results may reflect the lack of opportunity to conduct ADL in a nursing home setting. Many residents have the capacity but do not necessarily use it which, in the short or long run, could lead to loss of physical capacity. At baseline, 47–58% of our participants were afraid of falling which also can lead to avoidance of physical activity [8]. The residents are seldom given the opportunity to dress, make their bed or walk to the dining room by themselves due to safety concerns, busy staff or underestimation of their abilities [34]. Also the improvements seen in balance but not in ADL can most likely be explained by FIM, i.e. measuring per-

Table 4. Differences in physical functioning with respect to duration (<10 and ≥10 weeks) and amount (<150 and ≥150 min/week) of intervention

Outcome variables[a]	<150 min/week (n = 79)		≥150 min/week (n = 39)		p	<10-week period (n = 39)		≥10-week period (n = 84)		p
	mean	median	mean	median		mean	median	mean	median	
FIM a–m T1		38		51	0.32[b]		47		42	0.71[b]
FIM a–m T2		35		50	0.16[b]		40		38	0.83[b]
BBS T1		10		22	0.26[b]		16		12	0.76[b]
BBS T2		10		26	0.003[b]		11		17	0.65[b]
BBS Diff		–0.5		2.86	0.039[b]		–1.6		1	0.13[b]
NHLSD semi total T1		18		22	0.001[b]		21		21	0.97[b]
NHLSD semi total T2		20		28	0.001[b]		20		25	0.16[b]
NHLSD total T2		30		40	0.005[b]		30		35	0.54[b]
NHLSD total Diff	–0.30		1.72		0.69[b]	–6.65		2.86		0.05[b]
Gait speed – self-selected T1	0.40		0.48		0.019[c]	0.47		0.41		0.20[c]
Gait speed – self-selected Diff	0.01		0.02		0.62[c]	–0.03		0.03		0.49[c]
Gait speed – maximal T1	0.62		0.70		0.06[c]	0.67		0.61		0.43[c]
Gait speed – maximal T2	0.60		0.74		0.38[c]	0.64		0.68		0.52[c]
Gait speed – maximal Diff	0.03		0.06		0.54[c]	–0.04		0.08		0.05[c]
COVS T1		53		61	0.24[b]		56		55	0.35[b]
COVS T2		52		65	0.046[b]		48		56	0.80[b]

NHLSD semi total = extension of physical activity; NHLSD total = extension and dependency in physical activity; Diff = mean difference between baseline and follow-up.

[a] A high score on the NHLSD indicates a high physical activity level and more independence in mobility. A high score on the BBS indicates a better balance function. A high score on FIM or COVS indicates a high degree of independence in ADL. A high score on FES(S) indicates a high degree of fall-related self-efficacy. [b] Mann-Whitney test. [c] Student's t test.

formance not capacity. The results between and within groups are somewhat contradictive. For instance, in ADL no difference between groups was shown while a significant deterioration in ADL within the CG was demonstrated. This could be explained by the fact that the differences in mean change between groups were too small to reach significance. The IG maintained their median results over time, but the CG deteriorated and the difference within the CG was large enough to become significant.

The fact that the CG deteriorated in several functions over such a short period highlights the importance of opportunities for physical activity and rehabilitation in nursing homes. Peri et al. [34] concluded that older people experience a decline in physical activity level after moving to nursing homes, and that an increase in daily physical activity could help residents to maintain their physical function. As there is evidence that physical therapy has positive effects on mobility and physical functioning in older adults with impaired mobility, physical disability and/or multi-morbidity [35], it seems reasonable to offer exercise and physical activity to nursing home residents. Progressive decline in mobility and physical functioning is considered to be a major health concern. People with disability are able to regain some physical functioning, but are at high risk of recurrent disability. Therefore, large effects should not be expected when studying already physically impaired older adults. Moreover, a small positive intervention effect, or even maintenance of capacity in this population as found in this study regarding both mobility and physical functioning, can be considered of great value and clinical relevance [36]. Chair rise for example is a basic functional transfer task required for ADL. According to Mehr el al. [36], more than 60% of older nursing home residents have difficulties with chair rise and need assistance from caregivers. In our study, slightly more than 60% could actually rise from a chair without assistance. Mobility problems among older people are often related to a combination of impairments in balance, gait and lower limb strength [1,

4, 13]. A high-intensity functional exercise program for nursing home residents demonstrated that a significantly lower proportion of the participants in the exercise group deteriorated in indoor mobility [5]. In the present study, we were able to demonstrate a significant increase in both walking/wheelchair speed and level of physical activity after the intervention period. A meta-analysis of effects of physical therapy on mobility, physical functioning, physical activity and quality of life [35] could not prove any positive effect on physical activity and concluded that the level of physical activity in older (frail) people does not increase as an obvious or natural consequence of an exercise intervention.

The participants who had taken part in 150 min or more of intervention/week had a better balance function and were generally more physically active than those who had participated less, and they were also more physically fit, less afraid of falling and had spent less time in the nursing home at baseline. These factors could have an impact on the ability and willingness to participate in training. Participants who had taken part more than 10 weeks in the intervention significantly improved in physical activity level and walking/wheelchair speed, while participants who had participated less deteriorated. The inclusion of such frail persons as nursing home residents in a study often lowers the compliance rate and makes it difficult to draw conclusions about intervention effects over time. In a study by Brittle et al. [37], 82% completed all assessments, but only 43% attended all training sessions. In our study, 82.5% took part in the 3-month follow-up, and 68% of the IG completed the main part ($\geq$10 weeks) of the intervention period despite the fact that the majority of the participants were cognitively impaired to some degree. It may be difficult for cognitively impaired persons to participate in exercise programs due to dependence on assistance during the exercise session. This could be easier to compensate for with individualized training [13].

The individually tailored exercise program was probably a crucial factor behind the effect of intervention in our study. The development of individualized intervention strategies, based on characteristics unique for each person and related to the outcome of interest, was based on thorough individual assessments [18]. The training was also supervised by experts of rehabilitation who reinforce self-efficacy by mastery experiences within the residents and feedback from the therapists. Personal treatment goals were elicited in connection with an assessment specifying the physical, cognitive and activity skills deemed necessary for goal achievement. A continuous revision of the goals is crucial for the long-term results, and the involvement of the staff in the rehabilitative way of thinking is of great importance. Multimodal, patient-targeted, intervention programs that focus on physical exercise and cognitive performance while, at the same time, promoting psychological well-being and social interaction are most likely to have positive rehabilitation effects in elderly people [1, 4, 18].

As nursing home residents form a heterogeneous group and to be able to record even small effects, a great number of outcome measures were included. The instruments had been assessed in a previous paper [38], and no floor or ceiling effects were discovered, making them feasible for use in nursing home studies. The mixture of objective performance-based measures and subjective reports on function is recommended by the Frailty Working Group [39].

There are some limitations in our study. As the study was conducted in many nursing homes and data were collected by several testers, the reliability of data could have been affected. However, to minimize the threat to internal validity, we used reliable and valid measurements. Also, the testers took part in a training program on testing procedures in order to ensure high inter-rater test reliability. Furthermore, it is possible that the CG might have been 'contaminated' as the randomization was carried out within each nursing home ward and the intervention could have influenced the regular treatment of all residents. We argue, though, that the ordinary care was similar with respect to training opportunities as it mainly consisted of nursing care with very little focus on physical rehabilitation. Strengths of the study are factors such as randomization, blinding of testers and analysis both by ITT and per protocol. The frequency of training sessions (3–5 days/week) and the long period of intervention (12 weeks) also strengthened the study. Brittle et al. [37] concluded that two exercise sessions per week for 5 weeks may not be enough to induce change in mobility in older residents. However, it can be questioned whether 3 months of intervention is a sufficient time period for optimal benefit, or if a longer period would have been needed for participants to reach their full potential. In an exercise study of nursing home residents dependent in ADL, improved chair stand test could be demonstrated after 6 months, but not after 3 [13].

Cruise et al. [40] point out the need for more detailed knowledge about cost-effectiveness of interventions. In addition to functioning, quality of life and patient satisfaction, measures should also be used to assess outcomes. Some of these issues will be addressed in our future work.

Clinical Implications

Following an older adult's move to a nursing home, it seems important to evaluate physical function, and to plan adequate physical training and activities related to individual goals. The goals and activity programs should be revised regularly. Even with a small amount of physical training there may be an impact on physical functioning. The amount and duration of training seem to be positively related to the training effects.

Conclusions

Transfers, balance and physical activity level can be improved or maintained following 3 months of individually tailored physical and daily activities in nursing home residents. An intervention based on characteristics of a person and related to the person's individual treatment goals seems to be a feasible way of training, and both the duration (weeks) and frequency (min/week) of the intervention were shown to have an impact on the outcome.

As this study only deals with the effects of an intervention given by PT and OT, it would be of interest to investigate the effects of a closer cooperation between nursing staff, especially trained in a rehabilitative way of thinking, and PT/OT regarding goal setting and rehabilitation for nursing home residents.

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Disclosure Statement

The authors have no conflicts of interest to disclose.

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