Research Report

A High-Intensity Functional Weight-Bearing Exercise Program for Older People Dependent in Activities of Daily Living and Living in Residential Care Facilities: Evaluation of the Applicability With Focus on Cognitive Function

Background and Purpose. Knowledge concerning the applicability and the effect of high-intensity exercise programs is very limited for older people with severe cognitive and physical impairments. The primary aim of this study was to evaluate the applicability of a high-intensity functional weight-bearing exercise program among older people who are dependent in activities of daily living and living in residential care facilities. A second aim was to analyze whether cognitive function was associated with the applicability of the program. **Subjects.** The subjects were 91 older people (mean age=85.3 years, SD=6.1, range=68–100) who were dependent in personal activities of daily living and randomly assigned to participate in an exercise intervention. Their mean score for the Mini-Mental State Examination (MMSE) was 17.5 (SD=5.0, range=10–29). **Methods.** A high-intensity functional weight-bearing exercise program was performed in groups of 3 to 7 participants who were supervised by physical therapists. There were 29 exercise sessions over 13 weeks. Attendance, intensity of lower-limb strength and balance exercises, and occurrence and seriousness of adverse events were the outcome variables in evaluating the applicability of the program. **Results.** The median attendance rate was 76%. Lower-limb strength exercises with high intensity were performed in a median of 53% of the attended exercise sessions, and balance exercises with high intensity were performed in a median of 73% of the attended exercise sessions. The median rate of sessions with adverse events was 5%. All except 2 adverse events were assessed as minor and temporary, and none led to manifest injury or disease. No significant differences were observed in applicability when comparing participants with dementia and participants without dementia. In addition, there was no significant correlation between applicability and the MMSE score. **Discussion and Conclusion.** The results suggest that a high-intensity functional weight-bearing exercise program is applicable for use, regardless of cognitive function, among older people who are dependent in activities of daily living, living in residential care facilities, and have an MMSE score of 10 or higher. [Littbrand H, Rosendahl E, Lindelöf N, et al. A high-intensity functional weight-bearing exercise program for older people dependent in activities of daily living and living in residential care facilities: evaluation of the applicability with focus on cognitive function. *Phys Ther.* 2006;86:489–498.]

Key Words: *Aged, Dementia, Exercise, Frail elderly, Residential facilities.*

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High-intensity exercise programs (ie, training near an individual's maximum capacity) have been shown to improve lower-limb strength (force-generating capacity of muscle), balance, and mobility in older people who are healthy and those with moderate impairments.[1–6] To our knowledge, only 2 studies with a high-intensity exercise program involving older people with severe cognitive and physical impairments have been conducted.[7,8] However, in one of these studies,[7] the exercises were only one aspect of a multifactorial fall prevention program, and in the other study,[8] no information about the applicability of the program was presented. Therefore, knowledge concerning its applicability and effect is very limited for this group of older people.

Difficulties may exist for older people with severe cognitive or physical impairments to participate in a high-intensity exercise program due to, for example, dependence on assistance during the exercise session. In addition, applying appropriate exercise intensity may be difficult because of older people's diminished functions, fluctuating health status, and high prevalence of diseases such as depression, heart failure, and osteoporosis.[9] These characteristics also may lead to a high risk of serious adverse events. It therefore seems vital for trained, experienced supervisors to be involved in the planning and performance of the exercise program. No serious adverse events in high-intensity exercise programs among older people who are healthy and those with moderate impairments have been reported in the literature.[10,11] However, systematic and accurate registration of adverse events often is lacking in the studies.[1]

Mobility problems among older people are often related to a combination of impairments in balance, gait, and lower-limb strength, which also are risk factors for falls and dependency in activities of daily living (ADL).[12–14] It is therefore important to design an exercise program aimed at improving all 3 functions. Functional weight-bearing exercise programs have been shown to have wide-ranging effects on physical function among older people who are healthy and those with moderate impairments.[15–18] These exercises appear suitable for frail older people in residential care facilities, including those with severe cognitive impairment, because the exercises are easy to follow and there is no need for specific exercise facilities. By exercising with high load on the lower-limb muscle groups and near the limit of postural stability, the possibility arises of achieving high intensity for each participant. In addition, a functional weight-bearing training method that includes everyday tasks such as

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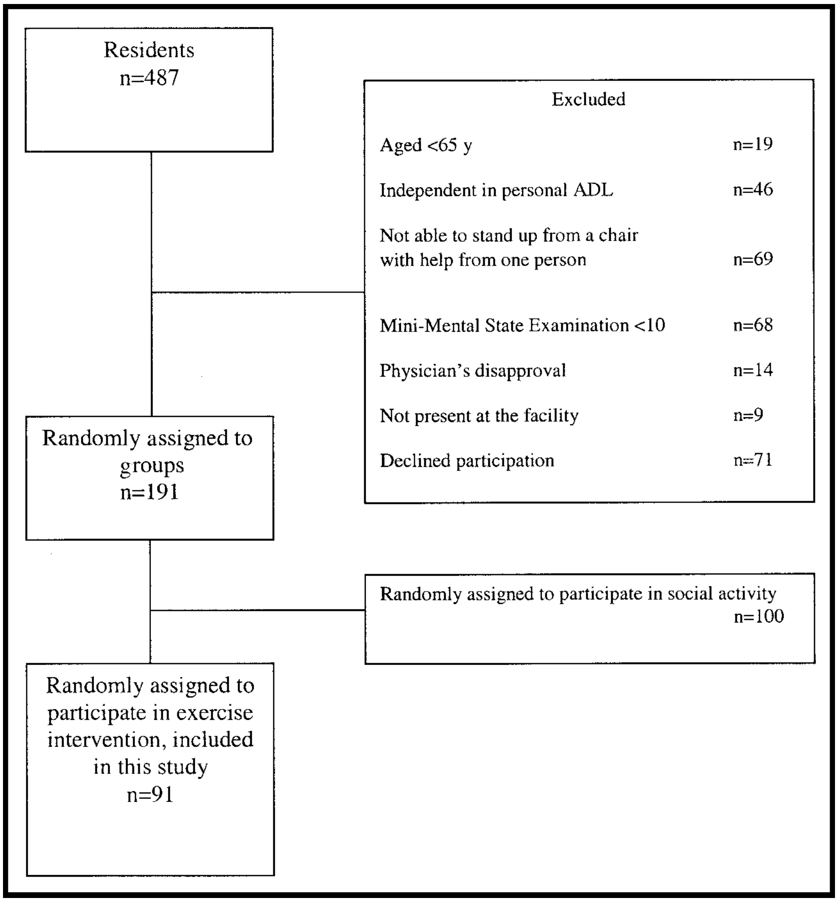

Figure.
Flow chart of the sample. ADL=activities of daily living.

rising from a chair or stair climbing may create favorable conditions for transferring the improvement in physical functions to performance in daily living.[19,20]

We recently completed a randomized controlled trial to evaluate a high-intensity functional weight-bearing exercise program for people who are dependent in ADL and living in residential care facilities, of whom most had severe cognitive or physical impairments. The exercise program had positive long-term effects on balance, gait ability, and lower-limb strength compared with a control activity.[21] The primary aim of the current study was to evaluate the applicability of this high-intensity functional weight-bearing exercise program with regard to attendance, achieved intensity, and adverse events. A second aim was to analyze whether cognitive function was associated with the applicability of the program.

Method

Setting

The study was performed with people who were randomly assigned to participate in an exercise intervention as part of the Frail Older People–Activity and Nutrition Study in Umeå (the FOPANU Study) at 9 residential care facilities in northern Sweden. All facilities comprised private apartments with access to dining facilities, alarms, and on-site nursing and care. Four facilities also included units for people with dementia (ie, private rooms with staff on hand).

Participants

Inclusion criteria were 65 years of age or older, dependent on assistance from a person in one or more personal ADL according to the Katz index,[22] able to stand up from a chair with armrests with help from no more than one person, a Mini-Mental State Examination (MMSE)[23] score of 10 or higher, and an approval from the resident's physician (who also could be consulted during the intervention).

Screening and Inclusion Process

All residents (N=487) were screened by a physical therapist. The residents who met the inclusion criteria were given written and oral information about the study. They were informed that participants would be assigned to 1 of 2 group activities (exercise or social activity) in the study. The residents or their relatives, when appropriate due to cognitive impairment, gave their informed oral consent. After the baseline assessments, 34 clusters of residents, according to units of the facilities, were randomly assigned to exercise or social activity by lots in sealed, nontransparent envelopes. Ninety-one people randomly assigned to participate in the exercise intervention were included in the study (Figure). Age, sex, and Katz ADL score did not differ between those who were randomly assigned to groups (n=191) compared with those who declined participation (n=71).

Baseline Assessments

At baseline, a registered nurse from each facility completed a questionnaire regarding diagnoses and clinical characteristics. Data on prescribed regular drugs were obtained. Mental tests and assessments of physical function were performed by a physical therapist. Cognitive function was assessed using MMSE, with a maximum score of 30[23]; a score of 17 or lower indicates severe cognitive impairment.[24] Licensed practical nurses or nurse's aides were questioned about ADL using the Barthel ADL Index, with a maximum score of 20.[25,26] Balance was assessed using the Berg Balance Scale, consisting of 14 balance tasks common in everyday life,

Table 1.
Baseline Characteristics of the Participants

Characteristic	Total (N=91)	Participants With Dementia (n=47)	Participants Without Dementia (n=44)
Age (y)			
X̄	85.3	84.5	86.1
SD	6.1	5.2	6.9
Range	68–100	73–96	68–100
Female sex, n (%)	67 (74)	35 (74)	32 (73)
Diagnoses and medical conditions, n (%)			
Depression	55 (60)	30 (64)	25 (57)
Delirium episodes, the last month	21 (23)	17 (36)	4 (9)
Previous stroke	26 (29)	7 (15)	19 (43)
Diabetes mellitus	14 (15)	7 (15)	7 (16)
Heart failure	25 (28)	11 (23)	14 (32)
Angina pectoris	27 (30)	14 (30)	13 (30)
Hypertension	28 (31)	15 (32)	13 (30)
Osteoporosis	23 (25)	11 (23)	12 (27)
Osteoarthrosis	17 (19)	8 (17)	9 (20)
Drugs for regular use, n (%)			
Diuretics	45 (50)	17 (36)	28 (64)
Nitroglycerin, with a long-acting effect	21 (23)	9 (19)	12 (27)
Analgesics	56 (62)	29 (62)	27 (61)
Benzodiazepines	35 (38)	15 (32)	20 (46)
Antidepressants	46 (50)	26 (55)	20 (46)
Neuroleptics	17 (19)	9 (19)	8 (18)
No. of drugs			
X̄	9.2	8.3	10.2
SD	5.0	4.4	5.3
Range	1–27	2–27	1–19
Functional assessments			
Mini-Mental State Examination			
X̄	17.5	16.0	19.2
SD	5.0	4.7	4.8
Range	10–29	10–29	11–29
Barthel ADL Index			
X̄	12.8	13.2	12.4
SD	4.5	4.3	4.8
Range	1–19	3–19	1–18
Independent gait indoors (with or without walking aid),[a] n (%)	56 (62)	29 (62)	27 (61)
Berg Balance Scale			
X̄	26.6	29.9	23.2
SD	15.3	15.1	15.0
Range	2–55	2–55	3–50
Able to rise from a chair independently without arm support,[b] n (%)	32 (35)	19 (40)	13 (30)
Functional Ambulation Categories			
Median	4	4	4
Interquartile range	2–4	3–4	1.25–4
Range	0–5	0–5	0–5
Geriatric Depression Scale (GDS-15), n=85 (46/39)[c]			
X̄	4.6	4.3	5.0
SD	3.4	3.4	3.5
Range	0–14	0–14	0–14
Philadelphia Geriatric Center Morale Scale, n=89 (47/42)			
X̄	11.1	11.5	10.7
SD	3.7	3.5	3.8
Range	2–17	2–17	4–17

(Continued)

Table 1.
Continued

Characteristic	Total (n=91)	Participants With Dementia (n=47)	Participants Without Dementia (n=44)
Body mass index, n=90 (47/43)			
$\bar{X}$	24.9	24.8	25.0
SD	4.4	4.4	4.6
Range	13.8–35.9	13.8–33.8	18.1–35.9
Mini Nutritional Assessment			
$\bar{X}$	20.4	20.1	20.8
SD	3.8	3.9	3.8
Range	10–27.5	11.5–27.5	10–26.5
Health, self-perceived as better than that of age-related peers,[d] n (%)	30 (33)	13 (28)	17 (39)

[a] Assessed with the Barthel ADL Index.[25,26]
[b] Assessed with the Berg Balance Scale.[27,28]
[c] Numbers after a characteristic indicate that there are missing assessments: total number of assessed participants (participants with dementia/participants without dementia).
[d] Assessed with the Mini Nutritional Assessment.[32]

with a maximum score of 56.[27,28] The Functional Ambulation Categories (FAC) was used to measure walking ability in 6 levels (0–5).[26,29] This categorization does not take account of any walking aid used. A score of 3 (verbal supervision or standby help from one person without physical contact) or less was chosen to indicate severe physical impairment. The need for personal support when walking a short distance (5–10 m) without walking aid was estimated by an assessment developed for this study. This assessment of basic motor skills in walking was used when selecting exercise categories in the program for each participant. The scores ranged from 1 to 4 (1=walking without any physical support or supervision, 2=walking with supervision or minor physical support from one person, 3=walking with major physical support from at least one person, and 4=not able to walk with major physical support). The interrater reliability for this assessment, assessed in 22 participants, was .95 (95% confidence interval=0.86–1.00) using weighted kappa. Depressive symptoms were screened using the Geriatric Depression Scale (GDS-15).[30] The Philadelphia Geriatric Center Morale Scale (PGCM)[31] was used to assess morale.

A dietitian assessed nutritional status by using the Mini Nutritional Assessment,[32] including body mass index (in kilograms per square meter). The Mini Nutritional Assessment has a maximum score of 30; scores between 17 and 23.5 indicate a risk of malnutrition, and scores below 17 indicate the presence of malnutrition.[32] A specialist in geriatric medicine evaluated the documentation of diagnoses, drug treatments, assessments, and measurements for completion of the final diagnoses. Dementia was diagnosed using the DSM-IV criteria.[33]

Baseline characteristics of the 91 participants are presented in Table 1. Forty-seven participants (52%) had severe cognitive impairment (MMSE score of 17 or lower), and 40 participants (44%) had severe physical impairment (FAC score of 3 or lower). Sixty-three participants (69%) had severe cognitive or physical impairment.

Exercise Intervention

The intervention was based on the High-Intensity Functional Exercise Program (the HIFE Program), which was developed for this study by physical therapists and can be obtained from the authors. The objective of the intervention was to improve the participants' lower-limb strength, balance, and gait ability. The exercise sessions, which lasted approximately 45 minutes each, were performed within the facility 5 times each 2-week period for a total of 29 sessions over 13 weeks. A schedule for all sessions was provided to the participants as well as to the staff at the facility. When needed, a verbal reminder or help with transfer to the exercise session was given by the staff or the physical therapists. The exercises were performed in groups of 3 to 7 participants and were supervised by 2 physical therapists. When a participant did not attend the group, individual exercises were offered if possible. The HIFE Program was distributed in written form (booklet with drawings and instructions) to the physical therapists, and a meeting was held before the start of the intervention in order to learn the program. The physical therapists (n=7) were all experienced in working with frail older people.

The HIFE Program was based on exercising in functional weight-bearing positions. The program included lower-limb strength and balance exercises, in standing and walking, performed at a high intensity, if possible, for each participant. The collection of exercises was developed according to 3 criteria: (1) applicable without access to special exercise facilities, (2) adaptable for frail

Table 2.
Collection of Exercises in the High-Intensity Functional Exercise Program (the HIFE Program): Categories and Examples[a]

Category	Name	Examples of Exercises
A	Static[b] and dynamic[c] balance exercises in combination with lower-limb strength exercises	Squat in a parallel or walking stance Step-up onto boxes Forward or side lunge
B	Dynamic balance exercises in walking	Walking over obstacles Walking on a soft surface Walking with numerous turns
C	Static and dynamic balance exercises in standing	Trunk rotation Body weight transfer in a parallel or walking stance Side step and return
D	Lower-limb strength exercises with continuous balance support	Squat in a parallel or walking stance Standing-up from sitting Heel-raise
E	Walking with continuous balance support	Walking in various directions Walking with numerous turns

[a] The HIFE Program, including the collection of exercises, can be obtained from the authors. The load in the lower-limb strength exercises can be increased by adjusting the performance of the exercise (eg, by doing deeper squats or doing step-ups onto a higher box) or by using a weighted belt worn around the waist, loaded with a maximum of 12 kg. The difficulty of each balance exercise can be increased, for example, by standing or walking with a narrower base of support or by standing or walking on a more challenging surface.
[b] Static balance exercises: fixed base of support.
[c] Dynamic balance exercises: changing base of support.

older people with different functional levels, including independent walkers and those needing help with all mobility, and (3) possibility for progression of the exercises in 2 ways—either to increase the difficulty in a specific exercise or to change to another, more challenging, exercise. In all, 41 exercises, distributed over 5 categories, were included in the collection of exercises (Tab. 2).

For the selection of exercise categories, a hierarchical model in the HIFE Program, based on the participant's walking ability without walking aid, was used as a guideline (Tab. 3). Within each category, the physical therapists selected exercises for each participant according to his or her functional deficits. The intensity of the exercises was self-paced, although the participants were encouraged by the physical therapists to exercise with a high intensity and to progressively increase the load or the difficulty in each exercise. The exercises were adjusted for each session depending on changes in functional and health status. It was recommended that the participants perform at least 2 lower-limb strength exercises and 2 balance exercises in 2 sets each session and that the exercises be preceded by a warm-up while sitting for 5 minutes. Strength exercises were intended to be performed at 8–12 repetition maximum (RM), thus increasing the load as soon as the participant performed more than 12 repetitions. For the first 2 weeks, 13–15 RM was recommended as a build-up period. The load of the leg extensor muscle groups was determined, for each strength exercise separately, during each session according to the participant's performance. The load was increased by adjusting the performance of the exercise (eg, by doing deeper squats or doing step-ups onto a higher box) or by using a weighted belt worn around the waist, loaded with a maximum of 12 kg. The balance exercises were intended to fully challenge the participant's postural stability (ie, to be performed near the limits of maintaining postural stability). The difficulty of each balance exercise was increased, for example, by standing or walking with a narrower base of support or on a more challenging surface. For safety reasons, the participants used a belt with handles worn around the waist so that the physical therapist could more easily prevent the participants from falling when challenging postural stability. All exercise equipment was portable.

Outcome

Attendance, intensity of lower-limb strength and balance exercises, and occurrence and seriousness of adverse events were the outcome variables in evaluating the applicability of the program. After each exercise session, the physical therapists completed a structured report for each participant, including exercises performed, reason for not attending the exercise session, estimated intensity of the lower-limb strength and balance exercises (Tab. 4), reason for not achieving high intensity, and adverse events. Adverse events during the exercise session were defined as discomfort that manifested itself or became worse because of the exercises. The adverse events were either expressed spontaneously by the participant or observed by the physical therapist. In addition, the physical therapist asked participants during the exercise session whether they experienced any discomfort.

Table 3.
Model in the High-Intensity Functional Exercise Program (the HIFE Program) for Selection of Exercise Categories

Physical Function Group[a]	Recommended Categories in the Collection of Exercises
Walking without any physical support or supervision (n=27)	A. Static and dynamic balance exercises in combination with lower-limb strength exercises B. Dynamic balance exercises in walking
Walking with supervision or minor physical support from 1 person (n=35)	A. Static and dynamic balance exercises in combination with lower-limb strength exercises B. Dynamic balance exercises in walking C. Static and dynamic exercises in standing
Walking with major physical support or not able to walk (n=29)	C. Static and dynamic exercises in standing D. Lower-limb strength exercises with continuous balance support E. Walking with continuous balance support

[a] The participant's need for personal support when walking a short distance (5–10 m) without walking aid. Number of participants categorized to the physical function group shown in parentheses.

The seriousness of the adverse events was assessed by 3 people (2 specialists in geriatric medicine and 1 physical therapist) independently in 4 different categories: (1) minor and temporary, (2) serious symptoms (potential risk of severe injury or life-threatening), (3) manifest injury or disease, and (4) death. In cases of disagreement between assessors, a consensus was reached after a discussion.

Data Analysis

Intention-to-treat analyses were used (ie, all participants were included in the analyses regardless of whether they participated in the exercise program or not). Four participants discontinued the exercise intervention—1 participant withdrew after detection of cancer, 1 participant died (cause not related to the exercises), and 2 participants were included in another study. Data of all 4 participants were included in all analyses.

An attendance rate was calculated for each participant as the number of attended sessions divided by total sessions (n=29). An intensity rate was calculated for each participant as the number of sessions of the specific intensity divided by total attended sessions. Likewise, an adverse event rate was calculated for each participant as the number of sessions with an adverse event divided by total attended sessions.

Dementia diagnosis and MMSE score were the variables used to evaluate whether cognitive function was associated with the applicability of the program. Rates for attendance, intensity (of high-intensity lower-limb strength and balance exercises), and adverse events were compared between participants with and without dementia using the Mann-Whitney *U* test (due to skewed distribution). The correlations between these rates and the MMSE score were analyzed using the Spearman rank correlation.

Analyses were performed using the SPSS software, version 10.0.* A *P* value of $<.05$ was considered to indicate statistical significance.

Results

Attendance

The attendance rate was in median (interquartile range) 76% (62%–93%). Six percent of the sessions were performed individually. The participants performed 5.1 ± 1.4 ($\overline{X} \pm SD$) different exercises per attended session. The most common reasons for not participating in an exercise session were the participant's lack of motivation (ie, that the participant declined due to lack of interest according to the physical therapist's judgment) (7% of the total sessions for all participants), acute disease (7%), hospital treatment or visit to the primary health care center (3%), and pain (3%).

Intensity of the Exercise

Lower-limb strength exercises of high intensity were performed in a median (interquartile range) of 53% (17%–72%) of the attended exercise sessions, and lower-limb strength exercises of medium or high intensity were performed in a median of 92% (85%–100%) of the attended exercise sessions. Corresponding figures for balance were 73% (40%–89%) for high intensity and 96% (89%–100%) for medium or high intensity. In 42% (14%–68%) of the attended sessions, both high-intensity lower-limb strength and balance exercises were performed. The most common reasons for not achieving high intensity for lower-limb strength and balance exercises were pain (11% and 4% of the attended sessions, respectively), lack of motivation (9% and 8%, respectively), build-up period in the start of the intervention period or after a disease or injury (8% and 5%, respectively), and fatigue (4% and 4%, respectively).

Adverse Events

In all, 179 adverse events occurred in 166 (9%) of the 1,906 attended exercise sessions among 57 participants (63%). For all participants, the median (interquartile range) rate of sessions with adverse event per attended session was 5% (0%–14%). All except 2 adverse events

* SPSS Inc, 233 S Wacker Dr, Chicago, IL 60606.

Table 4.
Intensity Scales of the Lower-Limb Strength and Balance Exercises[a]

	High Intensity	Medium Intensity	Low Intensity
Lower-limb strength exercises	Sets of 8–12 repetition maximum	Sets of 13–15 repetition maximum	Sets of >15 repetition maximum
Balance exercises	Postural stability fully challenged[b]	Postural stability not fully challenged or fully challenged in only a minority of the exercises	Postural stability in no way challenged

[a] The intensity scales were developed for this study. Intensity for each participant was estimated by the physical therapist for lower-limb strength and balance exercises separately, as an average for each exercise session.
[b] Postural stability fully challenged=balance exercises performed near the limits of maintaining postural stability.

Table 5.
Applicability of the Exercise Program Related to Dementia and Cognitive Function

Variable	Participants With Dementia (n=47)	Participants Without Dementia (n=44)	*P*	Correlation With the MMSE[a] Score	*P*
Attendance rate,[b] %	76 (59–93)	76 (63–93)	.619	.022	.833
High-intensity rate in strength and balance exercises,[c] %	29 (12–64)	50 (16–70)	.506	.115	.277
Adverse event rate,[d] %	7 (0–19)	4 (0–8)	.090	.073	.494

[a] MMSE=Mini-Mental State Examination.[23]
[b] Median (interquartile range): number of attended sessions divided by total sessions (n=29) for each participant.
[c] Median (interquartile range): number of sessions of high-intensity strength and balance exercises divided by total attended sessions for each participant.
[d] Median (interquartile range): number of sessions with an adverse event divided by total attended sessions for each participant.

were assessed as "minor and temporary," and none led to manifest injury or disease. Two adverse events were assessed as "serious symptoms"—one participant stopped training during an exercise session because of pain in the chest, and in one case the physical therapists prevented a fall by gently helping a participant down to the floor when losing balance. The adverse events were "musculoskeletal" (eg, pain or soreness) (53%), "dizziness" (22%), "respiration/circulation" (eg, breathlessness or discomfort from the chest) (18%), "general/unspecified" (eg, stomach pain) (4%), "psychological" (eg, fear of falling) (3%), and "near fall accident" (described above) (1%).

Association Between Applicability and Cognitive Function
Regarding attendance, intensity, and adverse events, no significant differences were observed when comparing participants with dementia (n=47) with participants without dementia (n=44), nor was there any significant correlation to the MMSE score (Tab. 5).

Discussion

The high-intensity functional weight-bearing exercise program was applicable for use among older people who were dependent in ADL and living in residential care facilities. Although most of the participants had severe cognitive or physical impairments, there was a high rate of attendance, a relatively high achieved intensity in the exercises, and only 2 serious adverse events, neither of which led to manifest injury or disease. The applicability of the program was not associated with cognitive function.

The attendance in this study appears somewhat lower than that of other studies of high-intensity exercise interventions among older people.[2–6] However, all these studies targeted participants with higher physical abilities than in the present study, and only one study included people with severe cognitive impairment.[2] Furthermore, none of these studies provided an attendance rate, including participants who dropped out before the post-intervention assessment. This factor may have influenced the attendance figures.

An important factor for the high attendance rate in this study, especially for the participants with severe cognitive impairment, was probably that reminders were used. In addition, help with transfer to the exercise location, a low rate of serious adverse events, and the positive effects of the exercise were other factors that probably had a positive influence on the attendance rate. The impact of these factors on attendance is supported by the results in another study.[34]

The rates for high intensity were high for balance exercises but moderate for strength exercises. The most common reason for not achieving high intensity in lower-limb strength exercises was pain, which was nearly 3 times more frequent as a reason compared with balance exercises. The high prevalence of pain conditions (indicated by common regular use of analgesics), osteoarthrosis, and osteoporosis might indicate difficulties in exercising with higher loads.

The rate of adverse events, including only 2 serious ones, may be seen as acceptable in this frail population, considering the relatively high intensity achieved. The approvals from the participants' physicians prior to the study were probably important for the participants' safety as well as the supervision by physical therapists who were experienced in working with frail older people and adjusted the exercises for each session depending on changes in the participants' health status. However, there was a nonsignificant tendency for people with dementia to experience more adverse events. No such tendency was observed when correlating adverse events to the MMSE score.

The number of registered adverse events seems valid, although collection was limited to the exercise sessions and participants with severe cognitive impairment were included. However, there may have been adverse events related to the exercises that were not recorded. To improve the quality of data for adverse events, information was collected by the physical therapist in different ways (by observing and asking the participants) in direct connection to the exercise session in order to reduce the impact of memory decline. Furthermore, the inclusion criterion of an MMSE score of 10 or higher was based on clinical experience that those people can follow simple instructions and provide reliable responses to uncomplicated questions regarding their current experiences. This clinical experience is supported by studies that have shown that people with severe cognitive impairment can express a meaningful opinion of their quality of life.[35,36]

The MMSE scores ranged widely, both in the participants with dementia and in those without dementia. All participants with a diagnosis of dementia despite having an MMSE score of 24 or higher had been diagnosed before the study after a conventional dementia evaluation. Some participants had no diagnosis of dementia despite having an MMSE score of 17 or lower. The specialist in geriatric medicine, who completed the final diagnosis in the study, could not diagnose dementia for these participants due to other reasons that could have influenced the test result of MMSE (eg, severe deficits in hearing and vision as well as deficits after stroke). The use of a well-established diagnostic manual (DSM-IV) increases the quality of data for diagnosis of dementia, but some degree of under-diagnosis could still be present. However, using the MMSE score to analyze the impact of cognitive function on applicability of the program provided similar results as using diagnosis of dementia.

The exclusion at baseline of people with an MMSE score of less than 10 or with needing more than one helper to rise from a chair limits the external validity of data obtained in the study. However, the use of randomization increases the external validity because the studied group included people accepting participation in a study with both exercise and social activity interventions. Another limitation was that the scales used to assess the intensity of strength and balance exercises were not tested for interrater reliability. However, the scales were defined before the intervention started, and all physical therapists were instructed on how to use them.

The main clinical implication of this study is that people with severe cognitive or physical impairments can be offered programs of high-intensity exercises performed in small groups. This is especially important for people with dementia because cognitive decline is associated with a decline in physical performance.[37,38] Counteracting this decline is important in order to achieve more independence in ADL. The exercise program used in this study (the HIFE Program) can easily be implemented due to the well-described exercises and the fact that procedure of selection of exercises for each individual is standardized. In addition, all of the necessary equipment is portable, thus making it possible to exercise without transfer to a health care facility. Future research is needed to determine whether the results of attendance, intensity, and adverse events obtained in the study can be replicated or improved, as well as whether they are related to the effects of the exercise program.

Conclusion

A high-intensity functional weight-bearing exercise program is applicable for use, regardless of cognitive function, among older people who are dependent in ADL, living in residential care facilities, and have an MMSE score of 10 or higher.

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