

Pragmatic exercise-oriented prevention of falls among the elderly: A population-based, randomized, controlled trial

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Abstract

Objectives. To assess the effectiveness of an intervention planned and implemented by regional geriatric care teams in order to prevent falls in an elderly population.

Methods. The study was conducted among 555 (67%) home-dwelling Finnish persons aged 85 years or older of a representative population sample ($N=827$) in 2000–2003. Altogether 486 subjects (88%) had a history of recurrent falls or at least one risk factor for disability in the activities of daily living or mobility and were randomly assigned to receive suggestions for a programme consisting of home exercise, walking exercise, group activities or self-care exercise or alternatively routine care. Falls were monitored for a median of 16 months during the intervention.

Results. The time to first four falls and all falls did not significantly differ in the targeted intervention group ($N=217$); compared to controls ($N=220$), hazard ratio 0.88 (95% CI 0.74 to 1.04) and 0.93 (0.80–1.09), respectively. Among those able to move outdoors, the corresponding hazard ratios in the intervention group ($N=168$) compared to the controls ($N=178$) were 0.78 (0.64–0.94) and 0.88 (0.74–1.05). After the intervention period, impaired balance was less common in the intervention than in the control subjects; 64 (45%) and 89 (59%) ($p<0.05$).

Conclusions. A pragmatic intervention was not effective in reducing the falling risk at the population level, but slowed down the reduction of balance performance. Among those able to move outdoors, the intervention was also effective in reducing the risk of first four falls.

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Introduction

Falls are common in older adults, as one third of home-dwelling persons aged 70 years or older fall yearly, half of them recurrently (Luukinen et al., 1994). In populations older than 80 years, the proportion of fallers is as high as 50% (Campbell et al., 1990).

Several interventions have been carried out to prevent falls (Chang et al., 2004). Among community-dwelling older adults, multifactorial interventions (Tinetti et al., 1994; Close et al., 1999) and interventions composed of exercise (Wagner et al.,

1994; Province et al., 1995; Wolf et al., 1996; Buchner et al., 1997; Campbell et al., 1997, 1999; Lehtola et al., 2000; Rubenstein et al., 2000; Robertson et al., 2001a,b; Day et al., 2002; Lord et al., 2003) have resulted in the most effective reduction of fall rates. The results of a meta-analysis of multifactorial trials indicate that systematic fall risk assessments and management of these risks are especially effective among older adults with a history of falls, while exercise interventions may be effective, regardless of type of exercise, in population samples of elderly people (Chang et al., 2004).

There is evidence that interventions also work in practice. In New Zealand, a nurse-delivered program on home exercise resulted in a reduction of falls (Robertson et al., 2001b) among community-dwelling adults aged 80 years or older able to move

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around in their residence and understand the meaning of the intervention.

Interventions aiming to improve functions among older home-dwelling adults with severe functional disability have not been successful (Gill et al., 2002; Stuck et al., 2002). The effectiveness of the daily work of geriatrics teams in the prevention of falls among the most elderly disabled populations has not been evaluated.

To further strengthen the evaluations concerning the implementation of fall prevention programmes, we evaluated the effectiveness of an intervention planned and implemented by a geriatric team to prevent falls among a home-dwelling population aged 85 years or older.

Methods

A randomized controlled trial was carried out to evaluate the effectiveness of a pragmatic programme consisting of home exercise, walking exercise, group exercise and self-care exercise on the incidence and risk of falling. The intervention programme along with the baseline and follow-up examinations were carried out by the geriatric nurses ($N=40$) of the home care service of the City of Oulu. This service is responsible for all home care of elderly people in the city.

Recruitment and randomization

The structure of the study population is described in Fig. 1. According to the official population register and the geriatric registers of the City of Oulu by

August 30, 2000, the home-dwelling population aged 85 years or older consisted of 827 persons. Altogether 555 (67%) subjects of this representative home-dwelling population sample were examined in their homes at baseline (October 16, 2000–March 26, 2001) after informed consent by the subject or her/his guardian (Lehtola et al., 2006).

The following risk factors measured at baseline were used to recruit the final study population for randomization: recurrent (>2) falls during the preceding year, frequent feelings of loneliness, poor self-rated health, poor visual acuity, poor hearing, depression, poor cognition, impaired balance, impaired chair rise and slow walking speed. Postal questionnaires according to Leinonen et al. (1996) were used to define frequent feelings of loneliness (moderately often/more seldom) and poor self-rated health (fairly poor or worse/average or better). Problems with vision were assessed with the question “do you have trouble with vision while moving” (yes/no) and hearing difficulties with a question concerning the ability to discriminate speech between three individuals (with great difficulty/some difficulty/better than that). Depression was assessed according to the short version of the Geriatric Depression Scale (De Craen et al., 2003). Cognitive status was assessed according to the MiniMental State Examination test (MMSE) (30–0) (Folstein et al., 1975), and poor cognitive status was defined as a test score of <20 . Balance was assessed by the nurse examiner as an ability to stand with the feet in a tandem position for 10 s (unable/able). Lower extremity function was assessed by an ability to rise up from a chair (5 iterations) without using one’s arms (unable/able). Walking speed was measured during a 2.4-m walk (m/s) (Guralnik et al., 1994), and slow walking speed was defined as <0.34 m/s (1 standard deviation below the mean of the population). Each of these risk factors was associated with physical and movement disability. Physical disability was characterized as a need for personal assistance or difficulty (without difficulty, with some difficulty, with great difficulty, unable without personal assistance, fully unable) in performing at least one of the following basic activities of daily living: toileting, washing, getting in and out of bed, eating, dressing and walking indoors (range of sum

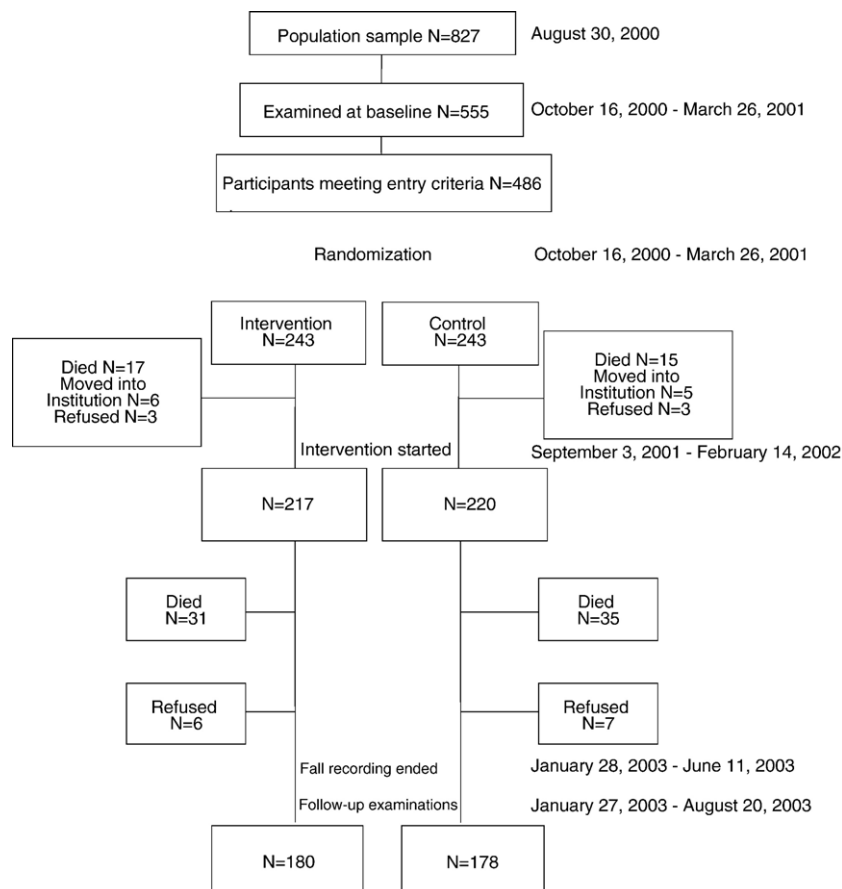


Fig. 1. Progress and follow-up of the study.

scores 6–30). The corresponding items concerning disability of movement were the ability to walk outdoors and up and down stairs (2–10) (Leinonen et al., 1996).

Altogether 486 (88%) subjects had at least one risk factor and were randomly assigned into the intervention and control groups. Randomization was done by the study statistician using a random numbers table.

Other baseline data examined by the nurse examiners included grip strength measured with the Jamar Hydraulic Hand Dynamometer (Trent Building, South Buckout St., Irvington, NY 10533, USA). Body mass index was calculated from measured weight in light clothing versus squared height (kg/m^2). Blood pressure (mm Hg) was measured twice (at a 10-min interval) with a mercury manometer with the subject in a sitting position. Blood pressure was defined as the mean value of the two measurements.

Use of health services (yes/no) during the past year (first aid in a health center, hospital first aid, health center consultation, hospital outpatient clinic consultation, private sector consultation) were asked in the postal questionnaires.

Interventions

The individual intervention plans were made during home visits by a physiotherapist and an occupational therapist based on the risk factors. They itemized the risk factors along with the recommended interventions on structured forms. Before the start of the interventions, each participant visited her/his family physician with this form of recommendations. In co-operation with the subject, the physician assessed the feasibility of the interventions planned by the physiotherapist and the occupational therapist. Home exercise was prioritized over the other interventions suggested. For a total of 121 (56%) subjects who had not previously done home exercise, a novel home exercise plan was approved, while 25 (12%) subjects who already exercised were requested to carry on with their established home exercise routines. Novel walking exercises were recommended for 56 (26%) subjects who had not been doing walking exercises, and the established exercises were recommended for 8 (4%). Correspondingly, group exercises were recommended for 46 (21%) and 49 (23%) and self-care exercises for 21 (10%) and 121 (56%). Novel home exercise was the main or only new intervention for 48 (22%), while group exercise, walking exercise and self-care exercise were prescribed as the only intervention for nine (4%), two (1%) and two (1%) subjects, respectively. Two kinds of interventions were prescribed for 45 (21%), three for 27 (12%) and four for 3 (1%) subjects.

The home exercise interventions included exercises performed in a standing position for those who could manage that: marching in place, rising and standing on toes, ankle extension and flexion, hip abduction, hip extension and transfer of weight from one foot to the other. Exercises in a sitting position were suggested for those unable to exercise standing: chair stands, marching in a sitting position, knee extension, hip abduction, ankle flexion and extension and rotation with extended knees. Exercises in a lying position were suggested if the subject was unable to exercise in a standing or sitting position. The suggested exercises were: raising the pelvis, lifting an extended lower extremity, flexion and extension of the foot without lifting it from the ground, abduction and rotation of the hip, flexion and extension of the ankles. These exercises were recommended to be done three times daily with 5–15 repetitions. Ankle cuff weights were not used, and the intensity of the exercise was not increased during the course of the intervention. Group exercises consisted mainly of physical exercises in small groups and rehabilitation for war veterans. The occupational therapist planned the self-care exercises, which aimed to improve the management of personal daily activities.

The control subjects were asked to visit their physicians without a written intervention form.

Primary outcome measures

A fall was defined as an unexpected event when a person fell to the ground from an upper level or the same level. Accidents with a moving car or bicycle were not included (Luukinen et al., 1994). Fall recording lasted from the baseline examinations (October 16, 2000–March 26, 2001) through the start of the intervention (September 3, 2001–February 14, 2002) until the end of the follow-up period, i.e., the last round of phone calls (January 28–June 11, 2003) (Fig. 1). Fall recording was based on regular phone calls to all participants made

every second month by a research nurse working in the university department. She was unaware of the randomization and the interventions. The research nurse examined the medical records of the local health center and the Oulu University Hospital in order to check the validity of the recording of fall-related injuries. The injuries included fractures, dislocations and soft tissue injuries needing suturing and even more severe injuries (Luukinen et al., 1995).

Secondary outcome measures

Follow-up examinations were carried out during January 27, 2003–August 20, 2003. Reduced grip strength, low body mass index, low blood pressure, low cognitive status, poor balance, inability to rise up from a chair (5 iterations) without using one's arms, slow walking speed and a high number of prescribed medications (examined on all data the subjects had available at home) were the secondary outcome measures recorded at the follow-up examinations.

Use of health services (yes/no) during the past year was inquired in the postal questionnaires.

In connection with the bi-monthly fall recordings, the research nurse inquired about the physical exercise done by the subject during the preceding 2 weeks. The frequency (times) and duration (minutes) of home exercise, walking (ordinary walking during the daily activities, including shopping) and group exercise (group gymnastics) were asked about, but the types of exercise were not inquired because the research nurse was blinded to the randomization. Self-care exercises were not included in this questionnaire.

Statistical analyses

Statistical power was calculated on the assumption of a 60% fall rate during a 11/2-year trial. Assuming a 30% drop-out rate, to show a 40% reduction in the fall rate, 200 subjects per group were needed ($\alpha=0.05$, power=80%).

Student's *t*-tests and corresponding non-parametric tests (Wilcoxon two-sample tests), as appropriate, were used to compare continuous data, and Chi-squared statistics were used to compare binary data. The numbers of fallers were reported. In addition, the fall rates and fall injury rates per year (Lamb et al., 2005) were calculated using the time to death, move to another area, refusal from recording or the end of follow-up as a denominator. For the controls, the times of the start of the monitoring of falls during the intervention were determined as the median time of start of interventions calculated from the intervention group. Andersen–Gill extension of the Cox regression model was used to analyse survival time until all falls (Province et al., 1995) and the first four falls (Campbell et al., 1997). The results are shown summarized as hazard ratios with 95% CIs. When appropriate, continuous variables were categorized through one standard deviation from the mean towards a greater risk.

Primarily, we used intention-to-treat analyses. In order to highlight the effects of the intervention among those with better physical abilities, secondary analyses were done among those able to move outdoors without personal assistance (without difficulty, with some difficulty or with great difficulty).

Computation was carried out using commercially available software (BMDP Statistical Software Inc., Los Angeles, California) on a SUN/UNIX mainframe computer (Sun Microsystems, Inc., Palo Alto, California).

Ethics approval

The study protocol was approved by the scientific ethics committee of Oulu University Hospital.

Results

Baseline subject characteristics

The similar baseline characteristics of the subjects in the intervention and control groups are presented in Table 1. Among those able to move outdoors, trouble with vision was less common in the intervention than the control population; 28 (16%) and 45 (26%).

Table 1
Distribution of baseline characteristics in the intervention ($N=217$) and control ($N=220$) groups

Characteristic	Intervention	Control
Age, years; mean (SD)	88 (3)	88 (3)
Body mass index; kg/m^2 ; mean (SD)	25 (4)	25 (4)
Systolic blood pressure, mm Hg; mean (SD)	151 (25)	152 (25)
Grip strength, kg; mean (SD)	19 (12)	20 (12)
Number of used medications; mean (SD)	6 (4)	6 (3)
MiniMental State Exam (30–0), points; mean (SD)	23 (4)	24 (4)
Male; N (%)	47 (22)	44 (20)
Trouble with vision ^a ; N (%)	45 (21)	55 (26)
Impaired balance with feet in tandem position ^b ; N (%)	101 (47)	106 (50)
Impaired chair stand ^c ; N (%)	74 (35)	81 (38)
Slow walking speed ^d ; N (%)	56 (27)	40 (20)
Recurrent ^e falling during the previous year; N (%)	57 (27)	58 (27)

The Oulu 85+ Study, Oulu, Finland, 2000–2003.

Numbers may differ because of missing data.

^a Subjective trouble with vision while moving.

^b Unable to stand 10 s with feet in tandem position.

^c Unable to rise from chair (5 iterations) without using one's arms.

^d ≤ 0.34 m/s.

^e ≥ 2 Falls Table 2.

The intervention and control subjects were similar in regard to the use of health services (first aid in a health center, hospital first aid, health center consultation, hospital outpatient clinic consultation, private sector consultation) ($p>0.05$ for each) during the year before the baseline.

Table 2
Fall rates per person year prior^a to and during^b the intervention, and Andersen Gill extension of the Cox model results for the first four falls and all falls in the targeted intervention group and the control group and the intervention and control groups able to move outdoors

Intervention Outcome variable	Falls/Person year (95% CI)	n	Hazard ratio (95% CI)	n	Hazard ratio (95% CI) ^c
Targeted intervention group					
$(n=217)$					
	Prior 1.16 (1.02–1.32)				
	During 1.15 (1.03–1.29)				
First four falls		217	0.88 (0.74–1.04)	215	0.86 (0.72–1.02)
All (1–17) falls		217	0.93 (0.80–1.09)	215	0.91 (0.77–1.06)
Control group					
$(n=220)$					
	Prior 1.02 (0.89–1.17)				
	During 1.23 (1.10–1.37)				
First four falls		220	1.0	214	1.0
All (1–17) falls		220	1.0	214	1.0
Intervention group able to move outdoors					
$(n=168)$					
	Prior 1.09 (0.93–1.27)				
	During 1.02 (0.89–1.17)				
First four falls		168	0.78 (0.64–0.94)	166	0.72 (0.59–0.88)
All (1–17) falls		168	0.88 (0.74–1.05)	166	0.83 (0.69–1.00)
Control group able to move outdoors					
$(n=178)$					
	Prior 0.98 (0.83–1.14)				
	During 1.15 (1.01–1.30)				
First four falls		178	1.0	175	1.0
All (1–17) falls		178	1.0	175	1.0

The Oulu 85+ Study, Oulu, Finland, 2000–2003.

^a Median 11 months.

^b Median 16 months.

^c Adjusted for age (for 1 year increase), sex (female/male), trouble with vision while moving (yes/no) and number of falls (0–10) prior to the intervention baseline.

Fall rates per year in the intervention and control groups before the start of the intervention period are presented in Table 2. The corresponding rates of falling injuries in the targeted intervention and control groups were 0.20 (0.14–0.28) and 0.13 (0.08–0.18). Among those able to move outdoors, these figures were 0.22 (0.15–0.31) and 0.11 (0.07–0.17).

Primary outcome measures

Altogether 126 (58%) and 136 (62%) of the intervention and control subjects fell during the intervention period, and 38 (18%) and 43 (20%) fell at least three times. Fall rates per year and Andersen–Gill extension of the Cox model results are presented in Table 2. No significant differences emerged between the targeted intervention group and the controls. Among those able to move outdoors, the crude and adjusted hazard ratios of first four falls were lower in the intervention group compared to the control group; 0.78 (0.64–0.94) and 0.72 (0.59–0.88), respectively.

The fall injury rates per year in the targeted intervention and control groups were 0.18 (0.13–0.24) and 0.19 (0.14–0.25), respectively. Among those able to move outdoors, the figures were 0.16 (0.11–0.23) and 0.16 (0.12–0.23). According to the Cox regression analyses, the hazard ratios of the first fall injury as regards the interventions among all participants and those able to move outdoors were 1.09 (0.70–1.68) and 1.07 (0.64–1.79), respectively.

Table 3
Distribution of interventions prescribed by the geriatric teams according to the abilities^a of the intervention subjects to move

Intervention	Able to go out (n=164)	Unable to go out (n=49)	<i>p</i> ^b
<i>Walking exercise</i>			
Novel ^c	37 (23)	18 (37)	0.047
Established ^d	73 (45)	13 (27)	
No intervention	54 (33)	18 (37)	
<i>Home exercise</i>			
Novel	89 (54)	31 (63)	0.319
Established	22 (13)	3 (6)	
No intervention	53 (32)	15 (31)	
<i>Group exercise</i>			
Novel	35 (21)	11 (22)	0.488
Established	40 (24)	8 (16)	
No intervention	89 (54)	30 (61)	
<i>Self-care exercise</i>			
Novel	10 (6)	10 (20)	0.007
Established	99 (60)	22 (45)	
No intervention	55 (34)	17 (35)	

The Oulu 85+ Study, Oulu, Finland 2000–2003.

^a Missing data for 4 subjects.

^b *p* is for trend (Chi-Square test).

^c New exercise of a kind not practiced by the subject prior to the intervention period.

^d Exercise practised by the subject prior to the intervention period.

Secondary outcome measures

Differences in the measured risk factors at the follow-up measurements between the intervention and control groups were small. The only statistically significant difference concerned impaired balance; 64 (45%) in the targeted intervention and 89 (59%) in the control group ($p < 0.05$). The corresponding figures were 45 (40%) and 71 (54%) among those able to move outdoors ($p < 0.05$).

Table 4

Changes in the frequency (in the last 2 weeks) and duration (minutes) of walking exercise, home exercise and group exercise from the pre-intervention^a period to the early^b and late^c intervention periods in the intervention subjects and the controls

Exercise	Early intervention		<i>p</i> ^d	Late intervention		<i>p</i> ^d
	Intervention	Control		Intervention	Control	
<i>Walking exercise</i>						
Frequency, <i>n</i> (SD)	(<i>n</i> =159)	(<i>n</i> =165)	0.133	(<i>n</i> =123)	(<i>n</i> =134)	0.023
Duration, minutes (SD)	-1.5 (5.2)	-2.5 (5.9)		-2.0 (5.9)	-3.8 (6.5)	
<i>Home exercise</i>						
Frequency, <i>n</i> (SD)	(<i>n</i> =52)	(<i>n</i> =54)	0.150	(<i>n</i> =39)	(<i>n</i> =45)	0.758
Duration, minutes (SD)	-1.5 (15)	-4.6 (13)		-7.2 (15)	-9.7 (16)	
<i>Group exercise</i>						
Frequency, <i>n</i> (SD)	(<i>n</i> =24)	(<i>n</i> =27)	0.080	(<i>n</i> =19)	(<i>n</i> =27)	0.357
Duration, minutes (SD)	1.6 (8.7)	-1.1 (10)		-6.4 (11)	-6.7 (11)	
<i>Group exercise</i>						
Frequency, <i>n</i> (SD)	(<i>n</i> =24)	(<i>n</i> =27)	0.015	(<i>n</i> =19)	(<i>n</i> =27)	0.265
Duration, minutes (SD)	0.7 (3.6)	-1.4 (3.9)		-0.4 (2.1)	-1.7 (3.6)	
<i>Group exercise</i>						
Frequency, <i>n</i> (SD)	(<i>n</i> =24)	(<i>n</i> =27)	0.015	(<i>n</i> =19)	(<i>n</i> =27)	0.265
Duration, minutes (SD)	1.2 (14)	-2.9 (16)		-11 (35)	-22 (42)	

The Oulu 85+ Study, Oulu, Finland, 2000–2003.

^a Pre-intervention=last phone interview before the intervention baseline.

^b Early intervention=first phone interview during the intervention (min 14–max 96 days from intervention baseline).

^c Late intervention=last phone interview during the intervention (min 371–max 610 days from intervention baseline).

^d *p* is for difference between intervention and control groups (Wilcoxon 2-sample test).

The distributions of the numbers of interventions recommended by the physiotherapist and the occupational therapist according to the subjects' ability to move are presented in Table 3. Novel walking exercise and self-care exercise were overrepresented among those unable to move outdoors.

Changes in the times and duration of walking exercise, home exercise and group exercise before the intervention baseline and until the early intervention and the late intervention periods are presented in Table 4. The intervention and control groups did not differ according to the number of active exercisers of any kind, as asked in the questionnaires before and during the intervention. Significant positive changes were seen in the durations of all kinds of interventions during the early intervention period and the times of walking exercise during the late intervention period. Similar statistically significant positive changes were seen among those able to move outdoors (data not shown).

The intervention subjects reported first aid in a health center, hospital first aid, health center consultation and hospital outpatient clinic consultation equally often as the controls ($p > 0.05$). Private sector consultations were less common in the intervention than the control group; 12 (9%) versus 25 (18%) ($p < 0.05$).

Missing data

The intervention subjects without follow-up data ($N=36$) had more often slow walking speed at baseline ($p < 0.05$), low cognitive status ($p < 0.01$), impaired chair stand ($p < 0.05$) and lower mobility scores ($p < 0.05$) compared to the subjects with follow-up data ($N=144$). Correspondingly, the control subjects without follow-up data ($N=26$) had poorer mobility scores ($p < 0.05$) and ADL scores ($p < 0.05$) compared to the subjects with these data ($N=152$).

Discussion

The present results showed that pragmatic interventions planned and implemented by regional geriatric care teams did

not significantly reduce the incidence and risk of falls in a very old, home-dwelling population. It was also found that the time to first four falls but not the time to all falls was prolonged among the subjects able to move outdoors. These findings are in accordance with earlier observations that interventions work best at early and reversible stages of the disablement process (Rubenstein and Stuck, 2001). Although exercise can delay progression of physical decline, severe functional disability restricts the potential benefits of exercise interventions (Gill et al., 2002).

The results confirm the previous finding that a programme implemented by community nurses under surveillance by physiotherapists in primary health care practice can reduce the fall risk (Robertson et al., 2001b) and improve balance (Gardner et al., 2002) among cognitively intact older adults able to move around their residence. Differently from this trial, our intention was to intervene in the exercise practices of all subjects, also including those with movement and cognitive disabilities. Importantly, we found that the interventions planned and implemented by the duty personnel were effective in slowing down the reduction of balance performance in a very old home-dwelling population. However, the interventions were not equally effective in falls prevention. In addition to exercise interventions, other kinds of interventions may enhance falls prevention among those with established disabilities. A multifactorial approach is preferred for those with multiple risk factors (Tinetti et al., 1994; Close et al., 1999; Rubenstein et al., 2001; Chang et al., 2004). In addition to gait training and balance exercise programs and advice on appropriate use of assistive devices, postural hypotension and cardiovascular disorders, such as cardiac arrhythmias, should be treated and medication should be reviewed and modified along with modification of environmental hazards (American Geriatrics Society, British Geriatrics Society, and American Academy of Orthopaedic Surgeons Panel on Falls Prevention, 2001; Kannus et al., 2005). Withdrawal of psychotropic medication may be more effective than home exercise in falls prevention (Campbell et al., 1999). Environmental modifications may also be effective (Nikolaus and Bach, 2003), even better than physical exercises among those with visual problems (Campbell et al., 2005).

Compliance with interventions was found to be relatively poor and short-lasting, regardless of the ability to move. This is not surprising: older adults are often unwilling to change their lifestyle and habits (Devor et al., 1994). The recommended physical activities should therefore be based on habits and skills learned earlier (Shephard, 1990). Patient compliance is the most common barrier to successful interventions (Fortinsky et al., 2004). Compliance with the exercise interventions among the most elderly subjects should be paid special attention, because the effectiveness of such interventions seems to be especially good in these age groups (Fiatarone et al., 1994).

Study strengths and limitations

This pragmatic intervention study has notable strengths. The generalizability of the results is good in a population-based trial. It also shed light on the availability of and compliance with

simple exercise interventions among the most elderly home-dwelling subjects. Furthermore, the study was conducted as part of their daily work by the personnel responsible for the care of the study participants. This allows direct recommendation of home-based interventions of this kind in geriatric health care.

The intervention also has limitations. Fall recording was based on regular telephone interviews once in 2 months, but did not include diary reporting. Monthly telephone interviews and diary reporting have been suggested to increase the validity of fall recordings (Lamb et al., 2005). The design was exceptional in that there was a delay between the baseline examinations and the start of the intervention. This was because the randomization, the planning of the interventions and the education of the geriatric teams took time. Therefore, we cannot assure similarity of the intervention and control groups at the intervention baseline. However, these limitations do not affect the main results concerning falls in the study, because the fall and injury rates prior to the intervention tended to be higher in the intervention group than among the controls. On the other hand, the positive results in falls prevention were based on secondary outcomes, limiting the strength of evidence. Furthermore, although home exercise was the main intervention, we cannot make precise statements about the kinds or combinations of exercises that should be prescribed for older adults aged 85 years or older in order to prevent falling.

Conclusions

These experiences can be used by geriatric teams responsible for the care of subjects aged 85 years or older. Overrepresentation of cognitive impairment among the intervention subjects without follow-up data suggests that these persons more easily than others get tired of interventions and may misunderstand or forget to do the exercises. Otherwise, we recommend the implementation of home-based exercise interventions to delay the impairment of balance among the most elderly home-dwelling subjects and to prevent falling among those able to move outdoors. Compliance with the suggested interventions should be paid special attention. Prevention of falls among disabled persons continues to be a major challenge in geriatric medicine.

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