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Home training with and without additional group training in physically frail old people living at home: effect on health-related quality of life and ambulation

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Objective: To test the effect of two exercise regimes on health-related quality of life (HRQoL) and ambulatory capacity.
Design: Randomized controlled trial.
Subjects: Seventy-seven community-dwelling physically frail people over 75 years of age (mean = 81, SD = 4.5).
Interventions: Home training (HT, $N=38$) comprised twice daily functional balance and strength exercises and three group meetings. Combined training (CT, $N=39$) included group training twice weekly and the same home exercises. Interventions lasted 12 weeks. Physiotherapists ran both programmes. Home exercises were recorded daily.
Main measures: HRQoL was assessed by SF-36, and ambulatory capacity by walking speed and frequency and duration of outdoor walks.
Results: Following intervention, CT improved the SF-36 mental health index significantly more than HT ($p=0.01$). The SF-36 physical health index ($p=0.002$) and walking speed ($p=0.02$) demonstrated improvements, but no group differences. Six months after cessation of intervention there was still overall improvements on the mental health index ($p=0.032$), borderline overall improvements on the physical health index ($p=0.057$), higher weekly number of outdoor walks for the CT group than for the HT group ($p=0.027$) and an improved habitual walking speed in the CT group only ($p=0.022$).
Conclusions: HT improved HRQoL and walking speed, but additional group training gave larger benefits on mental health. Group training away from home may be beneficial for mental health and ambulatory capacity.

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Introduction

Loss of independence and well-being caused by impaired functioning can be a distressing aspect of ageing.[1] Walking is a hallmark for functional performance in older people, and walking speed is related to independency in activities of daily life.[2] Over the past 15 years there has been growing evidence for the positive effect of exercise interventions on motor impairments[3–6] and selected mobility functions[7–9] in older home-dwelling people. Thus, exercise interventions should also improve perceived functioning and well-being to be salient in the lives of these people.

Quality of life (QoL) is about how well people live.[10] In ageing research QoL has been used as an umbrella term to describe a number of outcomes believed to be of importance in the lives of elderly people.[11] Medical researchers have restricted the focus of QoL to include only health-related quality of life (HRQoL). HRQoL is defined as the extent to which health impacts an individual's ability to function and his or her perceived well-being in physical, mental and social domains of life.[12]

A positive correlation has been reported between the degree of physical activity and HRQoL in old age.[13–15] Results are inconclusive as to whether structured exercises improve HRQoL,[5,16–22] and whether HRQoL varies with the type of exercises undertaken[23] and how such activity is organized.[24,25]

In an earlier paper we reported the effect on motor functioning of a three month combined training programme consisting of group exercises and home exercises (CT), as well as a programme of home training (HT) alone, in community-dwelling frail old people over 75 years of age.[26] We found no additional effect of group training, however. The aim of this paper is to assess the effect of the two exercise programmes on physical and mental aspects of HRQoL and ambulatory capacity.

Methods

The study was conducted in Norway. Six local districts were used as strata for randomization. After inclusion subjects in each district were randomized into one of two subgroups: a CT subgroup and a HT subgroup, by an independent research office using sealed envelopes. This gave subgroup sizes of 5–8 participants. Figure 1 illustrates flow of participants during the study period.

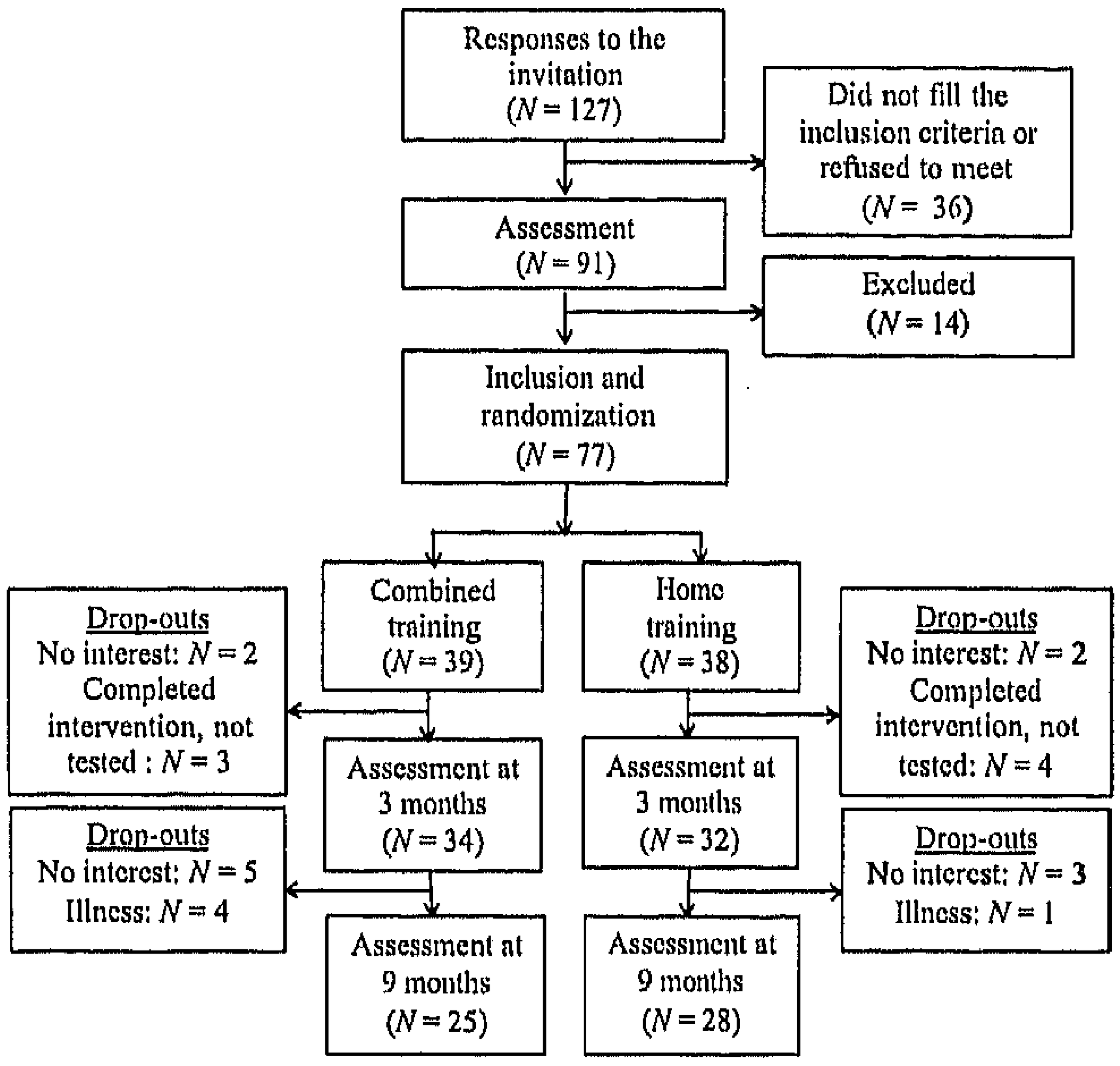

Figure 1 Flow diagram describing subjects during the study period.

Potential participants were at least 75 years old and regarded as physically frail, as they should meet at least one of the two following criteria: (1) had suffered at least one fall during the last year and (2) used some kind of walking aid either indoors or outdoors. Invitations to participate were distributed by health care workers and by announcement in the local newspaper, and 127 subjects responded. After initial assessments ($N = 91$) individuals were excluded if they exercised regularly more than once a week, had a terminal illness, had cognitive impairments (Mini Mental Status Examination (MMS) score < 22), had suffered a stroke during the last six months or were judged by a geriatrician not to tolerate exercise.

Participation was voluntary and in accordance with the Helsinki Declaration. Written informed consent was obtained from all assessed subjects. The regional ethical committee approved the protocol.

Subjects were assessed at baseline and at three and nine months follow-up by assessors blinded to the subjects' intervention status. Baseline registration included cognitive status by MMS[27] and functional status by Barthel/Mahoney Activities of Daily Living Index.[28]

HRQoL was measured by a generic and validated questionnaire, version 2.0 of SF-36[11,29–33] translated into Norwegian, and conducted as an interview. The 36 items in SF-36 are grouped into eight multi-item health status scales: physical functioning, role limitations due to physical problems (role physical), bodily pain, general health perception (general health), vitality, social functioning, role limitations due to emotional problems (role emotional) and mental health. For all 36 items raw scores were coded, grouped, summed and transformed to the eight 0–100 scales (0 = poorest possible health state, 100 = best possible health state) according to the SF-36 algorithms.[34] The physical functioning, role physical, bodily pain and general health scales were further aggregated to make a physical health index (scores ranging from 0 to 400). The vitality, social functioning, role emotional and mental health scales were aggregated to give a mental health index (scores ranging from 0 to 400).[34]

For the assessment of walking habits we asked subjects about frequency (0–7 days/week) and duration (minutes) of outdoor walks.[35]

For measurement of preferred and fast walking speed subjects walked back and forth along a 6-m walkway, where time was registered by photo cells for the middle 3 m. Mean of two trials was used as test parameter representing preferred speed and fast speed conditions. Based upon the two trials under each condition repeatability was estimated to intraclass correlation coefficient (ICC)(1,2) = 0.97 for preferred speed and ICC(1,2) = 0.93 for fast speed.

Satisfaction with taking part in the study was registered at three months by a 10-cm visual analogue scale (VAS), ranging from very displeased to very pleased. Scores were measured to the nearest millimetre by a ruler.

Intervention lasted for 12 weeks, from mid-September until mid-December. Twelve local physiotherapists, one for each of the six CT and six HT subgroups, were responsible for planning and running the interventions. Subjects randomized to either of the two training programmes were provided with transportation to group meetings, training sessions and test sessions.

Home training

Home exercises included four nonprogressive functional exercises aimed at improving balance and lower extremity muscle strength. All home exercises were instructed to be performed slowly for safety, and repeated 10 times, twice daily. The four exercises were: (1) Seated: Rise from a chair without arm support. (2) Standing: Rise to a tiptoe position. (3) One leg standing: Knee flexing on weight-bearing leg. (4) One leg standing: Maximal hip flexion of the nonweight-bearing leg. Exercises 3 and 4 were completed 10 times for one leg before changing to the other leg.

Three group meetings were organized for each of the six subgroups within the HT regime during the intervention. The purpose of the group meetings was to learn the exercises, motivate to keep on exercising and gain knowledge of the importance of being physically active for preventing functional decline and preventing falls. There was no contact between the participants of the HT subgroups and the physiotherapists between group meetings.

Combined training

First, subjects in the CT group were visited at home by a physiotherapist for the purpose of individual assessment, identification of home hazards and information about participation. Training classes were run twice a week for 12 weeks (24 sessions, 60 minutes each). There were 5–8 participants in each subgroup, and each training class was run by one physiotherapist. Each session started with a warm-up period of 10 minutes, and closed with a relaxation and stretching period of 10 minutes. The content of the main parts of the progressive exercise programme (20 minutes functional strength training and 20 minutes functional balance training) are detailed elsewhere.[26] Subjects were instructed to perform the same home exercises and with the same intensity as the HT group.

An aim of the study was to improve walking speed, and walking speed was used to calculate sample size. A mean change in walking speed of 0.07 m/s for the intervention group has been reported in earlier exercise studies.[36,37] A total sample size of 64 subjects, or 32 subjects in each group is required to find a difference in effect between groups of this magnitude, given a power of 80% and $\alpha = 0.05$.

All data were analysed according to intention to treat principles (ITT),[38] where missing data at three or nine months were replaced by the individual baseline test value.

Statistical procedures were performed in Excel 97 and SPSS version 11.0 for Windows. For all statistical tests a significance level of $p = 0.05$ was chosen. We did not adjust for multiple comparisons when analysing the eight scales of SF-36. We are aware of the increased probability of obtaining statistically significant results by chance when multiple significance tests are made, but this also assumes the statistical independence of predictor variables,[39] which was not the case here.[34]

Chi-squared tests, Mann–Whitney *U*-tests and *t*-tests for independent samples were used to compare baseline values between groups.

Since sample sizes were sufficiently large for the central limit theorem to be regarded as valid, parametric statistics were used in the analysis of SF-36.[37] Overall change was analysed using paired *t*-tests. Analysis of change between groups was performed in an analysis of covariance (ANCOVA) model where the dependent variable was the post test score either at three months or nine months, the independent variable was group and the covariate was the baseline score of the dependent variable.[37]

Results

Baseline characteristics of the two groups are shown in Tables 1 and 2. No significant differences were found between the groups, except for Barthel Index where the CT group scored better than the HT group (Mann–Whitney *U*-test: $z = -2.63$, $p = 0.01$). Figure 1 gives an overview on dropouts and subjects who completed the interventions during the study period.

Table 1 Baseline characteristics

	Combined training ($N = 39$)	Home training ($N = 38$)
Women; *N* (%)	31 (79.5)	31 (81.6)
Age (years); mean (SD)	81.3 (4.7)	80.9 (4.3)
Mental status (MMS); median (range)	28 (23–30)	28 (22–30)
ADL (Barthel Index); median (range)[a]	20 (16–20)	19 (16–20)
Number of prescribed medications; mean (SD)	3.7 (2.5)	3.4 (1.7)
Number of medical diagnoses; mean (SD)	4.4 (1.9)	4.3 (1.5)
Previous medical diagnosis; *N* (%)		
Stroke	7 (17.9)	9 (23.7)
Heart disease	15 (38.5)	17 (44.7)
Hypertension	14 (35.9)	12 (31.6)
Respiratory disease	4 (10.3)	6 (15.8)
Diabetes mellitus	3 (7.7)	5 (13.2)
Muscular/skeletal disease	28 (71.8)	31 (81.6)
Cognitive impairment	2 (5.1)	2 (5.3)
Depression	7 (17.9)	5 (13.2)
Incontinence	10 (25.6)	13 (34.2)
Visual impairment	22 (56.4)	20 (52.6)
Hearing impairment	20 (51.3)	14 (36.8)
Syncope	4 (10.3)	6 (15.4)
Epilepsy	0 (0)	0 (0)
Other	3 (7.7)	1 (2.6)

SD, standard deviation; MMS, Mini Mental State Examination; ADL, activity of daily living.
[a]Barthel Index was significantly higher in the combined training group than in the home training group ($p = 0.01$).

Table 2 Self-reported mobility and self-care at baseline

	Combined training ($N=39$)		Home training ($N=38$)	
	n	%	*n*	%
Mobility				
Used walking aid	27	69.2	30	78.9
Had fallen previous year	28	71.8	20	52.6
Took outdoor walks ≤ 1 hour/week	11	28.2	12	31.6
Took outdoor walks ≥ 3 hours/week	15	38.5	14	36.8
Self-care				
Lived alone	31	79.5	29	76.3
Could not leave the house without personal assistance	19	48.7	19	50.0
Had home cleaning service	18	46.2	20	52.6
Had home safety alarm	18	46.2	20	52.6

Satisfaction with the programme registered at three months by VAS demonstrated better satisfaction with taking part in the study ($t = -2.58$, $p = 0.013$) in the CT group (mean = 8.9 cm, SD = 1.7 cm) than in the HT group (mean = 7.6 cm, SD = 2.2 cm).

Subjects in the CT group participated on average in 21 of 24 (range 14–21) or at 87.5% of the training sessions, and subjects in the HT group at 2.5 of the three group meetings. Subjects from both groups were asked to perform twice-daily home exercises, and record each day whether they had performed the exercises nil, one or two times. During the intervention period subjects from the CT group ($N = 36$) reported to have completed a mean of 1.35 home training sessions per day (67.5%), whereas subjects from the HT group ($N = 35$) reported a mean of 1.29 training sessions per day (64.5%) of the two recommended daily home training sessions. We did not encourage home exercises to be performed between three and nine months' follow-up. During this period, 26 subjects from the CT group and 20 from the HT group reported continuation of the home training.

SF-36 baseline scores were not different between groups for any of the eight health status scales ($0.16 < p < 0.88$). From baseline to three months (Table 3) role emotional improved significantly more in the CT group than in the HT group ($p = 0.003$), while physical functioning demonstrated borderline group differences ($p = 0.07$) in favour of the CT group. Figure 2 illustrates the physical and the mental health index scores for both groups at all three test occasions. The mental health index improved significantly more in the CT group than in the HT group from baseline to three months ($p = 0.01$), explained by improvement in the CT group only. Group differences were not significant for the physical health index ($p = 0.12$).

Significant overall changes from baseline to three months were found for physical functioning, role physical, vitality and mental health (Table 3). Lack of overall change for role emotional is explained by a decrease in the HT group. In the same period the physical health index demonstrated an overall increase ($p = 0.002$). Mean improvements in the CT group and the HT group were 34 and 14 points.

At nine months, none of the SF-36 scales ($0.10 < p < 0.93$) nor the mental health or physical health indexes ($p = 0.11$ and 0.55) were different between groups. We found, however, significant overall improvements in role emotional ($p = 0.01$) and the mental health index ($p = 0.032$), as well as borderline differences for the physical health index ($p = 0.057$).

Both groups increased their preferred walking speed and fast walking speed from baseline to three months (Table 4), but we found however no group differences. Only the CT group improved preferred walking speed from baseline to nine months.

The number of weekly walks decreased from baseline to three months ($p < 0.001$) and to nine months ($p = 0.023$). At nine months the CT group but not the HT group had recovered their baseline frequency ($p = 0.016$). Mean walking time did not increase following intervention.

Since Barthel Index was different between groups at baseline, we performed an ANCOVA

Table 3 Effect of exercise on the eight SF-36 health scales. Changes are measured from baseline to closure of intervention (three months), and from baseline to nine months

	Combined training ($N = 39$)			Home training ($N = 38$)			Overall change, p-values[a]	Group differences, ANCOVA[b]
	Mean	SD	Change, p-values[a]	Mean	SD	Change, p-values[a]		
Physical functioning								
Baseline	54	23		47	19			
Three months	61	24	0.005	49	23	0.49	0.014	0.07
Nine months	57	24	0.23	47	24	0.95	0.35	0.22
Role physical								
Baseline	49	37		55	30			
Three months	67	41	0.012	60	36	0.29	0.007	0.17
Nine months	51	43	0.72	69	43	0.036	0.07	0.10
Bodily pain								
Baseline	66	29		64	30			
Three months	70	26	0.32	69	27	0.22	0.11	0.98
Nine months	69	29	0.39	67	27	0.34	0.19	0.93
General health								
Baseline	62	24		56	23			
Three months	66	25	0.12	58	23	0.41	0.09	0.29
Nine months	60	28	0.44	58	24	0.41	0.97	0.36
Vitality								
Baseline	44	19		45	24			
Three months	48	18	0.12	49	20	0.13	0.03	0.75
Nine months	44	19	0.98	47	20	0.41	0.50	0.38
Social function								
Baseline	79	31		83	25			
Three months	82	30	0.47	80	24	0.50	0.93	0.47
Nine months	82	28	0.48	81	28	0.64	0.86	0.57
Role emotional								
Baseline	66	40		79	33			
Three months	84	32	0.003	72	39	0.13	0.12	0.003
Nine months	83	33	0.007	82	37	0.54	0.01	0.16
Mental health								
Baseline	74	17		73	18			
Three months	80	15	0.012	75	14	0.35	0.012	0.10
Nine months	75	14	0.35	72	15	0.68	0.89	0.26

[a]Paired t-tests.
[b]Baseline value of the dependent variable as co-variate.

analysis with baseline Barthel Index score as controlling variable to investigate the effect of the intervention between groups and within groups. This analysis did not affect the conclusions, however, and details are not reported here.

To see whether functional level was associated with changes in the SF-36 physical functioning scale following intervention, we applied a multiple regression model with physical functioning at three months as dependent variable, baseline preferred

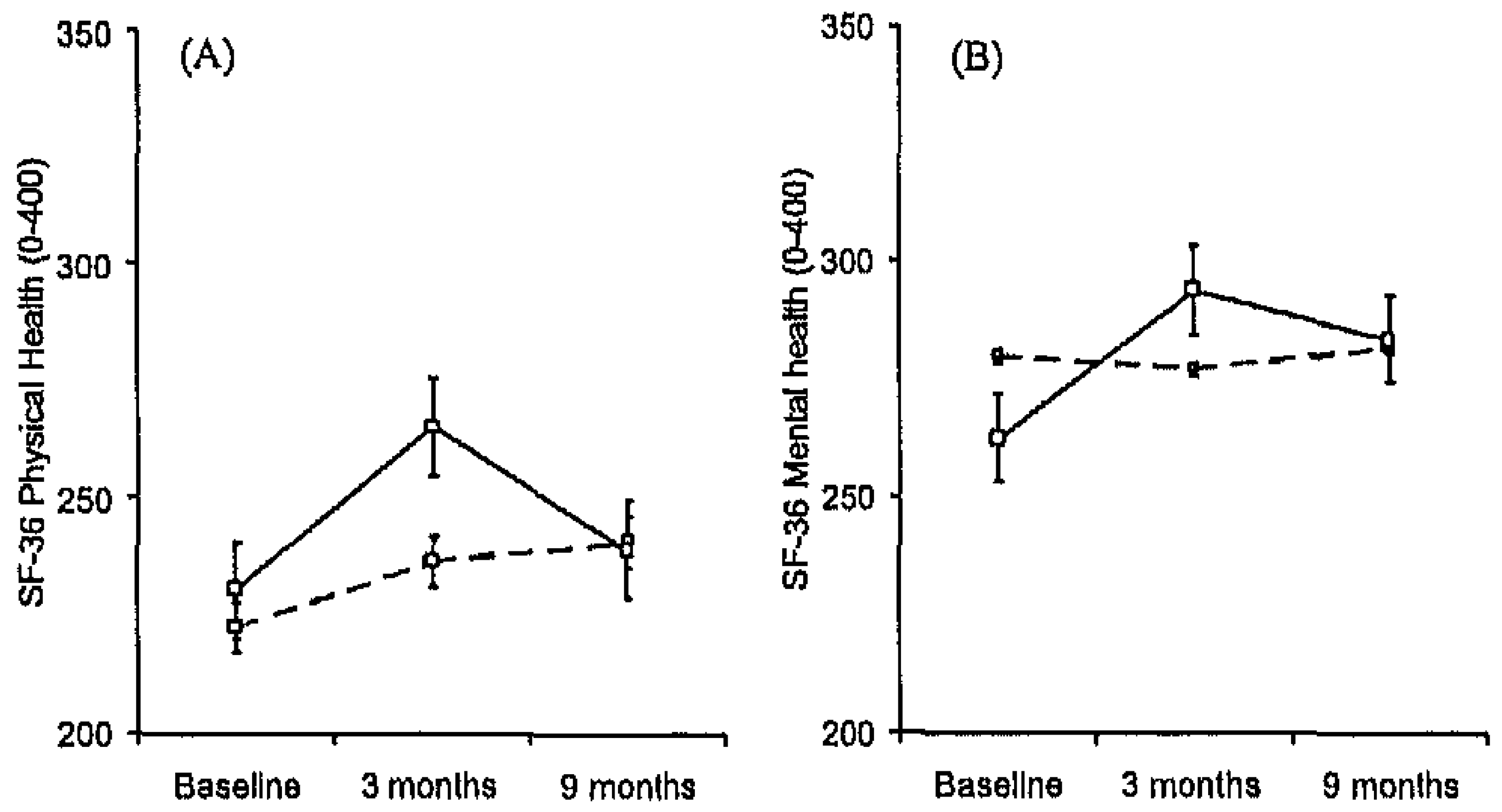

Figure 2 Mean (±SE) SF-36 physical health index (A) and mental health index (B) at baseline, three and nine months for combined training group (solid line) and home training group (dashed line).

walking speed, baseline physical functioning and group as independent variables (Table 5). The model suggested a positive correlation between baseline preferred gait speed and improvements in physical functioning ($p = 0.004$).

To test the effect of age and frailty on improvements in preferred walking speed, we used ANCOVA models with preferred walking speed at three months as outcome variable and baseline preferred walking speed, group and age, alternatively number of medical diagnoses as independent variables. Neither age ($b = 0.00$, $t = -0.13$, $p = 0.90$) nor number of medical diagnoses ($b = 0.003$, $t = 0.50$, $p = 0.62$) explained difference in outcome, however.

Discussion

A combined training programme consisting of group exercises and home exercises improved mental health more than a programme of home exercises only. Physical health and walking speed improved overall, but with no group differences.

The lack of significantly greater improvement in the SF-36 physical health index for the CT group compared with the HT group is in accordance with what we found for walking speed and what we have previously reported for other performance measures of motor functioning.[26] It is of interest that

Table 4 Effect of exercises on walking speed and walking habits. Changes are measured from baseline to closure of intervention (three months), and from baseline to nine months

	Combined training $N = 39$			Home training $N = 38$			Overall change, *p*-values[a]	Group differences, ANCOVA[b]
	Mean	SD	Change, *p*-values[a]	Mean	SD	Change, *p*-values[a]		
Preferred walking speed (m/s)								
Baseline	0.66	0.20		0.69	0.18			
Three months	0.69	0.20	0.29	0.73	0.19	0.007	0.02	0.40
Nine months	0.71	0.22	0.022	0.71	0.20	0.41	0.02	0.32
Fast walking speed (m/s)								
Baseline	0.89	0.32		0.91	0.31			
Three months	0.96	0.29	0.006	0.97	0.30	0.016	<0.001	0.38
Nine months	0.88	0.34	0.34	0.94	0.31	0.75	0.86	0.50
Number of weekly walks								
Baseline	4.7	2.9		4.5	3.0			
Three months	3.3	3.0	0.001	3.1	3.0	0.002	<0.001	0.91
Nine months	4.6	3.0	0.84	3.3	3.0	0.012	0.023	0.016
Walking time (minutes/week)								
Baseline	169	219		146	145			
Three months	137	142	0.40	117	145	0.18	0.16	0.65
Nine months	160	146	0.81	109	134	0.12	0.29	0.14

[a]Paired *t*-tests.
[b]Baseline value of the dependent variable as co-variate.

Clinical messages

- Daily home training followed up by physiotherapists may improve physical and mental aspects of health-related quality of life in physically frail old people.
- Taking part in additional group training improves mental health more than home training only and has the potential to improve ambulatory capacity.

group training gave no additional effect over home training, even if the programme used trained physiotherapists as instructors, and the exercises and dosages have been found to be effective in other studies for similar populations.[9,40,41] It is therefore likely that the home training was a sufficient incitement to improve motor functioning and physical aspects of HRQoL in the short run in this group of relatively inactive frail old persons. We suggest that longer training periods may be needed for these persons to absorb total amount of training offered in our study. Other studies reporting gradual increase in functioning during longer training periods[8,36] support such a notion.

Mental health showed greater improvements in the CT group than in the HT group, as indicated by group differences in change for the mental health index. At baseline, about half of the participants in our study had physical limitations that hampered them from going out, and thereby restricted them socially. The HT programme may not have met demands for social contact and sense of belonging for the participants. In contrast, the CT group training was accomplished at health care centres, and participants were provided with free transportation to get there. The training groups therefore included social elements that the HT programme missed. Additionally, the participants in the CT group were closely followed up by a physiotherapist, which may have increased the participant's confidence related to health perception. It is therefore not surprising that satisfaction with the project was better in the CT group than in the HT group.

Table 5 Multiple regression of physical functioning at three months on baseline preferred walking speed, baseline physical functioning and group

	b	*t*	*p*
Baseline preferred walking speed	28.2	3.0	0.004
Baseline physical functioning	0.7	8.7	< 0.001
Group (HT = 0, CT = 1)	8.0	2.3	0.025

b = regression coefficient. Total model summary: $R^2 = 0.62$, $F = 40.3$, $p < 0.001$.

The largest difference in change between groups for single SF-36 scales was found for role emotional, which includes questions related to problems with daily activities as a result of emotional problems. Other studies have reported effect of training on mental aspects of HRQoL, but have not shown group differences between home training and group training.[24,25]

Even if we failed to find group differences in change in physical health and motor functioning, it is of importance that we found beneficial effect in both groups. The improvements may be explained by a high compliance to the home training in both groups. Home training requires a high degree of motivation. The incentive to carry through the home exercises may have been related to monthly reports on the amount of training, as also reported elsewhere.[41] Additionally, the exercises were chosen to be relevant for daily life functioning and may have been perceived as meaningful.

Not all physical and mental health scales improved, however. Lack of change for any of the groups in bodily pain may be explained by the fact that the intervention did not focus on this aspect. Further we can conclude that the intervention did not affect the general health perception and social function.

Interestingly, six months after cessation of intervention there was still an overall effect on the mental health index and borderline significant effect on the physical health index. For the mental health index overall change was explained by an increase for the CT group only (Figure 2). The sustained effect on HRQoL indicates that the intervention had caused changes in self-perceived health. A persistent effect of HRQoL has also been reported by others six months after cessation of an occupational therapy intervention.[42] A longer follow-up period is needed to explore if the sustained health effect causes long-lasting differences in measured motor functioning.

During the intervention period we found an overall decrease in number of outdoor walks and lack of increase in walking time. Baseline testing was performed in September and three months assessments in the middle of December, when hazards of snow and ice refrain frail old people from outdoor activities in Norway. Reduced physical activity for old people during winter in the Nordic countries has also been reported by others.[43] This study cannot answer whether the exercise programmes had a potential to increase walking activity. It is interesting, however, that we found group differences in favour of the CT group for number of weekly walks at nine months, which was tested in June. Even if there was no overall improvements in walking from baseline to nine months in the frail old people, the additional group training may have influenced the ability or incentive to take walks. Preferred walking speed, which is a measure of habitual walking, also increased in the CT group in the same period. A transfer of training effect to habitual daily life activities is a prominent goal for most exercise interventions, and favours the CT programme in this study.

The lack of associations between old age and high number of medical diagnoses with improvement in walking speed indicates that age and frailty did not restrict the effect of training on ambulation. However, we found those with the best initial walking speed had the largest improvements in the SF-36 physical functioning following intervention. This is in contrast to what has been found in samples of more fit and younger old persons.[11] It is possible that improvements in physical functioning in the weakest people in our study were not large enough to affect the physical functioning scale.

This study has some important limitations. The recruitment of participants to the study by announcement in the newspaper or by health care workers may have given a sample of well-motivated participants. The results can thus not be generalized to all home-dwelling older people with mobility problems. Further, the relatively small sample size may have caused nonsignificant findings that might have been uncovered by larger samples. The study had no control group receiving no intervention. However, others have reported lack of change for such groups,[36] and therefore the effect found in this study is more likely explained by improvements caused by taking part in the exercise regimes. Because we had drop-outs during the study period we analysed data following ITT principles. This may have increased the probability of not overestimating the clinical effect, and thus increased the ecological validity of the results.

We conclude that home training has the potential to improve motor functioning and HRQoL in frail old people, but that additional group training gives greater mental health benefits. Even if home training is feasible and inexpensive, participating in training programmes outside home is preferable as this intervention fulfils social needs, bolsters mental health, and has a potential to improve ambulatory capacity over time.

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