

# A Randomized Controlled Trial of a Home Exercise Programme for Elderly People with Poor Mobility

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## Summary

Eighty-six elderly people with limited mobility and dependence in at least one activity of daily living were recruited to a home exercise study. The subjects (mean age 82 years) were allocated at random to either a strength exercise group, a mobility exercise group or a health education group. Subjects were visited for 30 minutes every 3–4 weeks by a physiotherapist who gave both verbal and written instruction. Sixty-nine of the original 86 completed the 6-month study, with five drop-outs from the strength group, ten drop-outs from the mobility group, and two drop-outs from the health education group. By the end of the study, there were no significant differences between the groups with regard to changes in outcome variables. The results showed a trend towards improvement in both the exercise groups in both Sit to Stand and Timed Get Up and Go tests, but this failed to attain statistical significance. Further work is required to identify the optimal exercise intervention for this subgroup of the elderly population.

## Introduction

There is growing interest in the effects of exercise on elderly people, although much of the work has concentrated on the highly selected subgroups of the 'young active old' population [1–4]. Only recently has this work been extended to the more challenging and clinically important groups of frailer old people, including those living in institutional care [5–8]. Many studies have involved highly selected samples and have been dependent on the use of expensive specialized training equipment, so limiting the applicability of the findings [7–11]. If exercise is to be widely adopted by elderly people it should ideally be enjoyable, inexpensive, and achievable by most old people. We wished to develop a 'low technology' approach to home exercise provision for elderly people with restricted mobility. Our study design adopted an inclusive approach to subject recruitment and required neither large amounts of therapist time nor the purchase of specialist equipment.

## Subjects and Methods

Subjects were recruited from the resident population of 26 local authority and private sheltered housing complexes selected at random from the 38 in the Dundee area. Inclusion criteria were: (1) aged 75 years or over, (2) limited mobility requiring the use of a walking aid, and (3) dependence in functional activities of daily living requiring the assistance of a home help at least once per week. Subjects with major neurological disease, unstable cardiovascular disease or severe cognitive impairment were excluded ( $n = 42$ ).

General practitioners were notified of their patients' involvement in the study. The study was approved by the Tayside Committee on Medical Ethics and written informed consent was obtained from the volunteers. Eighty-six subjects volunteered to participate and were randomly assigned to a home strength exercise programme ( $n = 25$ ), a home mobility exercise programme ( $n = 31$ ), or a home health education programme ( $n = 30$ ). Randomization was performed using sealed envelopes supplied in sequence by the co-ordinator of the study (M.E.T.M.) prepared from computer generated random number tables.

*Measurements:* All the measurements were made by the same trained research assistant who was 'blind' to the intervention received. The measurements were made in the subject's own home at the same time of day at baseline and at 6 months, when all variables were assessed without reference to baseline values.

Functional mobility was assessed using the Timed Get Up And Go Test [12]. Subjects were asked to rise from a chair of standard height (45 cm), walk to a line 3 m away at a safe and comfortable pace, turn, return to the chair and sit down again.

Lower limb strength was assessed using the Sit to Stand Test [13]. The time to complete ten full stands from a seated position in a standard-height chair (45 cm) was recorded with a stopwatch to the nearest 0.1 s. Grip strength was measured using a Takei dynamometer with the subject standing, holding the dynamometer by his/her side in the dominant hand. The best of three efforts was recorded [14].

Dynamic postural control was measured using Functional Reach [15]. The Functional Reach apparatus is an adjustable device which measures movement in a horizontal plane. It was wall- or door-mounted, in the horizontal plane at shoulder height. Subjects were asked to reach as far forward as they

could in the same plane, without taking a step forward. Results were expressed as a mean value of the three performances.

Spinal mobility was measured from an erect standing position, and the subject was asked to bend over to reach as near to the floor as possible, while maintaining knee extension [16]. This composite measure of spinal and hip flexion was recorded from the tip of the fingers to the floor using a centimetre tape. The results were expressed as a mean value of three attempts.

Activities of Daily Living were measured by the Barthel Index, scored on the basis of self-reporting by the subject [17]. Quality of life was assessed using the Philadelphia Geriatric Center Morale Scale [18].

**Exercise programmes:** Subjects were visited at home for 30 minutes every 3–4 weeks by an experienced physiotherapist (R.J.), instructed about their exercise programme, and encouraged to comply with it. The subjects were asked to complete their programme of 24 individual exercises at home, on their own, on a daily basis. Safety and respect for pain were emphasized throughout. The exercise sessions took approximately 15 minutes to complete. The exercise programmes were provided in diagrammatic form on a double-sided card with written explanation.

The first section of the exercise programme was common to both mobility and strength exercise groups. Initial stretching exercises of the hips, lower spine and calf were carried out, followed by range-of-movement exercises for the arms, hips, knees and ankles, and hip flexion, extension and abduction exercises. Subjects were asked to complete five to ten repetitions of each exercise. All standing exercises were conducted with support of a chair or a work surface.

The strength exercise programme used looped resistive elastic bands (Therabands) to provide the resistive force. Therabands are colour-coded in progressively thicker bands that provide increased resistance. The sequence of colours with increasing difficulty is yellow, red, green and blue. All subjects started with the yellow band which requires a force of approximately 27 N to stretch the band to double its length. The subjects were asked to perform between five and ten repetitions of each of the seated and standing exercises in the mobility exercise programme, working against the resistance of a Theraband where possible.

In the health education programme, subjects were visited at home for 30 minutes every 3–4 weeks by an experienced

physiotherapist (R.J.). Informal discussion took place on the topics of exercise, diet, sleep, meditation, stress, foot care and safety in the home, and was supplemented by health-education leaflets produced by the authors.

**Other baseline information:** The number of daily medications and the score on the Mini-Mental State Examination [19] were noted. The pre-study activity level of the subjects was classified using a three-point arbitrary scale: (1) Confined to the house and unable to climb stairs; (2) Occasionally walks outside, less frequently than three times per week, able to climb a few stairs; (3) Able to walk outside with an aid (distances less than 0.5 km), and able to manage stairs.

**Statistical analysis:** For each variable, we measured the change that had occurred during the study by subtracting the baseline from the 6-month values. The results of this calculation were normally distributed for all variables, except for the Timed Get Up And Go and the Sit to Stand tests. The differences between the three groups were therefore analysed statistically using the Kruskal–Wallis test for the non-parametric results, and One-Way Analysis of Variance for the other variables. Statistical analysis was performed using the Statgraphics computer software.

## Results

The mean age of the participants was 82 years, with a range of 75–96 years. Of the 86 subjects assigned to the study groups, 69 (80.2%) completed the 6-month project. There were no significant differences between the groups at baseline (Table I). In the strength exercise group, five subjects dropped out (three hospital admissions and two withdrawals). In the mobility exercise group ten subjects dropped out (three hospital admissions, three deaths, and four withdrawals). In the health education group, two subjects dropped out owing to hospital admission. Neither the hospital admissions nor the deaths were related to the exercise interventions, and there were no adverse events.

By the end of the 6-month project, there were no significant differences between the groups with regard to changes in any of the outcome variables (Table II). The results showed a trend towards improvement in

Table I. Baseline characteristics of volunteers completing study

Characteristic	Study group		
	Strength (n = 21)	Mobility (n = 20)	Health education (n = 28)
Mean (SD)			
Age (years)	81.4 (3.4)	82.9 (4.4)	81.9 (4.7)
Sex ratio	19F:2M	17F:3M	25F:3M
*Body Mass Index	27.5 (5.5)	27.5 (5.3)	25.9 (4.0)
Regular medications	2.9 (1.6)	2.4 (1.7)	3.2 (1.6)
Activity level	2.6 (0.6)	2.1 (0.8)	2.2 (0.9)
MMSE	26.4 (3.7)	24.9 (3.4)	26.7 (3.4)
Median (range)			
Barthel Index	19 (15–20)	19 (14–20)	18 (16–20)

\* Weight/height<sup>2</sup>.

Table II. Change in variables (6 months-baseline)

	Study group			p value
	Strength	Mobility	Health education	
Median (range)				
Up and Go (s)	-0.1 (-2.9 to 21.6)	-1.8 (-6.9 to 17.2)	0.1 (-18.3 to 47.1)	0.29
Sit to Stand (s)	-4 (-128 to 13)	-6 (-46 to 19)	-1 (-65 to 74)	0.37
Barthel Index	0 (-1 to 2)	0 (-3 to 1)	0 (-1 to 1)	0.98
Mean (SD)				
Grip strength (N)	15.7 (35.3)	9.8 (29.4)	10.8 (34.3)	0.77
Functional reach (cm)	4.5 (7.2)	1.4 (8.0)	1.3 (7.8)	0.26
Spinal mobility (cm)	-0.89 (5.7)	-1.7 (4.1)	-2.1 (7.7)	0.83
Philadelphia Geriatric Center Morale Scale	0.24 (2.4)	-0.75 (2.5)	-0.78 (2.1)	0.22

both exercise groups in both Timed Get Up and Go and Sit to Stand tests, in comparison with the control group. This failed to attain statistical significance.

An estimate of statistical power was not possible prior to the study owing to lack of information in the literature concerning the likely standard deviations in our study population. However, analysis of the results indicates that the sample size used provided an 80% power to detect a 20% change in grip strength, Timed Get Up and Go and Functional Reach, assuming statistical significance at the  $p < 0.05$  level. Owing to the large standard deviation in the Sit to Stand test results however, the sample size had only a 50% power to detect a 20% change with statistical significance.

## Discussion

This study has failed to demonstrate an effect of a home exercise programme on functional outcome measures in elderly people with restricted mobility living alone. The exercise programme comprised standard exercises aimed at working the main muscle groups, and putting the large joints through a full range of movement. A similar supervised group programme of seated exercise was effective in yielding functional improvement and increased quadriceps strength in a group exercise programme for elderly people in institutions [5]. The lack of effect in the current study may have been due to poor exercise compliance by the participants. As both self-reported compliance with exercise and daily diary records were considered to be highly susceptible to bias, neither was recorded in this study. A major challenge of any exercise programme is sustaining compliance, and it is possible that the monthly visits used in this study were not sufficiently frequent to ensure adherence. The level of cognitive impairment in the study population may also have contributed to compliance problems.

Another possible explanation of the negative result is that the outcome measures used were insensitive to the exercise interventions under study. Functionally-based outcome measures were chosen for this study in

response to the growing recognition that laboratory measurements of strength and power do not correspond perfectly with the results of everyday functional ability [20]. Other investigators have used chair rise time (similar to the Sit to Stand test) in trials of resistive exercise programmes in elderly subjects, and also failed to show an effect [21], although stair climbing power has been found to be sensitive to exercise intervention [7].

The Timed Get Up and Go test is a derivative of the Get Up and Go Test [22], and has been advocated as a means of measuring small yet clinically significant changes in mobility of frail patients where a change in functional capacity is otherwise difficult to document objectively [23]. It was not sensitive to the interventions used in our study.

The lack of an effect on Functional Reach supports the majority of reported work which has failed to demonstrate an effect of exercise on balance of elderly people [4, 24, 25]. Others have failed to demonstrate an improvement in Functional Reach during rehabilitation [26].

In general, a consistent trend towards improvement was shown in the strength exercise group comparison with the other two groups, but this failed to reach statistical significance. The increasing variance with age in almost all physiological variables is well recognized [27], and our findings reflect a large degree of inter-subject variability in our study sample.

We believe that our study involves a number of methodological improvements over some other work in this field. The study design was a randomized controlled trial and the pre-study and post-study assessments were made by a single 'blind' observer not otherwise involved in the project. Use of a 'blind' observer overcomes the strong tendency to expectation bias inherent in exercise trials, particularly if the outcome assessments are also being made by the individual who provided the exercise intervention.

Our project is the first trial to examine the feasibility and effectiveness of targeting exercise advice at individual older people in their own homes. The

interventions used were chosen so as to need no specialist equipment. They could, if successful, be readily adopted into clinical practice at only modest cost.

Elderly people with poor mobility living alone have limited opportunities to exercise, even if motivated to do so. Some institutions now provide exercise groups led by a visiting exercise therapist, and more active old people can avail themselves of exercise classes in the community. Neither of these options is available to most of our study population, who are constrained by frailty, transport problems and lack of facilities.

Frail elderly people potentially have the most to gain from exercise, by maximizing residual function. Further work is required to identify ways of targeting suitable elderly people living alone with restricted mobility who would benefit from exercise, and to describe the optimal exercise intervention.

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#### Further Information

Copies of the exercise programmes and health education information used in this study are available from the authors. Therabands are available from The Hygenic Corporation, 1246 Home Avenue, Akron OH 443.

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