Age and Ageing 2008; **37:** 57–63
doi:10.1093/ageing/afm135
Published electronically 25 October 2007

Does functionally based activity make a difference to health status and mobility? A randomised controlled trial in residential care facilities (The Promoting Independent Living Study; PILS)

KATHRYN PERI[1], NGAIRE KERSE[2], ELIZABETH ROBINSON[3], MATTHEW PARSONS[1], JOHN PARSONS[1], N. LATHAM[4]

[1]School of Nursing, University of Auckland, Auckland, New Zealand
[2]Department of General Practice and Primary Health Care, University of Auckland, Auckland, New Zealand
[3]Department of Epidemiology and Biostatistics, University of Auckland, Auckland, New Zealand
[4]Boston University, Boston, Massachusetts, USA

Address correspondence to: K. Peri. Email: k.peri@auckland.ac.nz

Abstract

Objectives to determine whether a repetitive activities of daily living (ADL) activity programme improves health status, life satisfaction and mobility for older people living in residential care.
Design cluster randomised controlled trial.
Setting five low-level dependency residential care homes in Auckland, New Zealand.
Participants one hundred and forty-nine older residents (mean age 84.7 years).
Intervention trained research staff worked with residents in intervention wards to set a goal and complete a functional assessment for each resident. They then designed an individualised activity programme based on ADL and worked with residential care home staff to implement the programme into daily activities of residents.
Measurements mobility: timed-up-and-go (TUG); life satisfaction: late life satisfaction index (LSI-Z); and health status: SF-36 were assessed at baseline, 3- and 6-months follow-up.
Results in the intervention group the SF-36 total physical component summary (PCS) score improved at 3 months in comparison with the control group. There was no difference between groups on mobility measures at any time, nor any measures at 6-months follow-up. Significant contamination is likely to have affected the 6-month follow-up measures.
Conclusions a repetitive ADL exercise programme may improve health status in the short term in a group of frail older people living in residential care. Further research is needed to establish sustainability of change.

Keywords: *older people, functional exercises, goal setting, long-term care, randomised controlled trial, elderly*

Introduction

Age-related reduction in muscle strength and power, cardiovascular function and neuromuscular response times, all contribute to the declining physical ability with age [1, 2]. Activity and exercise improve health status, muscle strength, aerobic capacity, and reduce fracture risk [3] as well as improving quality of life [2, 4]. Increasing habitual exercise can assist older people in maintaining functional performance [5], even for those in residential care [6] with the very frail having the most to gain from becoming regularly active [1].

At least 30% of older people experience decline in physical activity after entry into residential care [7]. Participation in activity programmes is more difficult for older people because of fear, lack of motivation, depression and poor understanding of the long-term benefits of physical activity [8]. Effective physical activity interventions have been developed for populations in residential care [9]. Successful programmes include: progressive resistance training [10] and strengthening and balance exercises [11, 12]. These interventions were resource intensive, requiring exercise facilitators, physiotherapists and extra staff, constraining widespread dissemination. Staff

within residential care are constantly under pressure limiting implementation efforts for intensive programmes.

Few trials have attempted to increase habitual activity by incorporating more usual activities into everyday life. Successful examples in the community have not been replicated on more frail populations [13].

We developed a repetitive activities of daily living (ADL) programme designed to increase physical activity and functional ability for long-term care residents, that incorporated individualised goal setting. Goal setting aims to improve self-efficacy, a potential predictor of adherence to exercise programmes for older people [14, 15]. Tailoring activity around an individual's specific functional goal may promote participation and deliver a more realistic and practical long-term increase in physical activity [16].

This paper reports the results of a randomised controlled trial testing the impact of this intervention on mobility, life satisfaction and health status of frail older people living in long-term residential care.

Methods

A cluster randomised controlled trial design was used to test the effectiveness of the individualised functional goal-setting programme.

This study was approved by the Auckland Ethics Committee.

Setting and participants

The study was conducted in five residential care homes (subsequently called homes) in Auckland, New Zealand. These homes are low-level dependency homes (equivalent to some assisted living facilities in the USA or hostels in Australia). Residents are commonly ambulatory and need minimal assistance with transferring, are independent in eating, but dependent in instrumental ADLs. The sample of homes included two 'for profit' and three 'not for profit' homes. These homes volunteered their participation in the study as part of a partnership between the University of Auckland and the residential care industry in the development of quality improvement programme.

Eligibility criteria and recruitment

Exclusion criteria for residents were: under the age of 65 years, admission for respite or terminal care; and quadriplegia. All other residents regardless of cognitive or physical ability were eligible for participation and were invited to take part by research staff. Written consent was obtained from one senior management staff of the home. All residents or their family members, when participants could not consent for themselves, were invited to participate and gave written informed consent.

Randomisation and blinding

Two similar wings were identified by researchers and management staff and allocated to either the intervention or control group by the toss of a coin performed by an independent researcher [17]. All residents in each wing were then offered participation. A research nurse blinded to the allocation, then collected baseline, 3- and 6-month outcome measures.

Measures

Demographic and health details including age, gender, length of stay in the care setting, care needs level, current medications and co-morbidities were recorded from the medical chart at baseline. The Abbreviated Mental Test was administered to assess mental status [18], and the Barthel Index assessed function at baseline [19].

Outcomes

The primary outcomes for the trial were change in health status and mobility over time.

Mobility was assessed using the Elderly Mobility Scale (EMS), a measure of observed function incorporating common activities such as getting on and off the bed and functional reach, and the timed-up-and-go score (TUG) [20, 21].

Health status was assessed using all the SF-36 two summary scales for physical health (physical component summary, PCS) and mental health (mental health component summary, MHCS) [22]. Satisfaction with life was measured using the Life Satisfaction Index (LSI-Z) [23].

Adverse events

Adverse events: muscular aches and pains, fatigue and number of falls, were recorded by self report every 2 months using an interviewer assisted questionnaire administered by an independent researcher, blinded to group allocation.

The control group

Residents received usual care and were offered the opportunity at the conclusion of the trial to participate in the goal setting physical activity intervention.

The intervention group

Registered nurses and health care assistants attended two educational sessions about the study prior to the intervention commencing in the home. The first educational session provided an overview on resident centredness and the rationale for increasing function in frail older populations. The second provided information about the intervention; and practical training about delivery of the activities of daily exercise programme.

The intervention was an activity programme developed by a trained gerontology research nurse and delivered by usual caregivers as follows:

(i) Goal setting phase:

The gerontology research nurse visited each resident twice during the goal setting phase. The first visit facilitated setting a goal volunteered by, and significant to, the resident. The second visit assured the resident's set goal encompassed physical functionality. Examples included gardening in raised garden beds, walking down to the local shopping centre or attending a community-based senior citizens club.

(ii) Gerontological nursing assessment:
The gerontology research nurse completed a comprehensive functional assessment of each resident using a health assessment tool developed by the research team including a medication review and referral to the resident's general practitioner about any medical problems identified. Occupational therapist and physiotherapist assessments were available to support the gerontological nurse only if the allied health professional was part of the usual staff at the home.

(iii) Development of Promoting Independent Plan (PIP):
Using information from the functional assessment, a prescriptive activity programme was developed and tailored to meet the identified goal. The activities were designed to increase the resident's strength, balance and endurance through increasing the usual level of activity by repeating ADL. The repetitive activities included bed mobility, sitting to standing, and transfers to various surfaces and heights. This meant that a resident transferred from bed to chair several times instead of once, completed a series of sit-to-stands in the resident's bedroom, the dining room and the lounge, and increased walking distances by taking a longer route to the dining room and incremental walking distances outside. The emphasis throughout was resident centred and followed the principle that incrementally increasing repetitions of exercises will increase activity tolerance and support goal attainment [10].

(iv) Health care assistant training:
The individualised programme was explained to both the resident and health care assistant by the research gerontology nurse with the emphasis on how the activities would support the resident in achieving their goal. The prescriptive care plan was prominently displayed in the resident's room and included in the medical record. The health care assistant was responsible on a daily basis for ensuring that residents carried out their activity programme.

The resident and health care assistant received weekly visits from the gerontology nurse for the first month to provide on-the-job training to the health care assistant and to review the individualised exercise programme. Fortnightly visits continued for the following 2 months, and monthly visits thereafter until the completion of the study at 6 months.

The residents' individualised plan was reviewed monthly at a staff meeting attended by the research staff, health care assistants and nurse manager. Goals were modified or reset by the resident, if requested, following the review meeting.

A compliance recording sheet was developed and used in two homes where staff recorded observed compliance on a daily basis. The other three homes relied on health care assistants recording compliance daily in the residents' case notes.

Sample size and power

To show a clinically relevant change of three in the physical component score of the SF-36 was not due to chance alone; we required a sample size of 67 in each group (90% power, 0.05 alpha), adjusted for the design effect of a clustered sample, using an estimated intra-class correlation of 0.01 for physical component score. This number of people also resulted in 96% power to detect changes in the mobility measure EMS, and 95% power to show change in the LSI-Z, life satisfaction measure.

Statistical analysis

Descriptive and summary statistics were produced using SPSS release 12. Outcome analysis was by intention-to-treat maintaining all participants in their original groups. Repeated measures analysis was used to investigate the change in SF-36 scores over the 6 months. Specific hypotheses tested using contrasts were the change between baseline and 3 months and the change between baseline and 6 months. Linear mixed models with time as a repeated measure and an autoregressive correlation structure were used. Age, gender, Barthel and mental test score were included in the models. Rest home was included as a factor to adjust for clustering.

Results

Baseline characteristics

The size of the homes varied from 28 to 72 beds. Two of the larger homes comprised two separate complexes on the same site. The other three homes were single complexes made up of separate wings. Care delivery in each wing was administered independently with no crossover of staff or residents during the study period. Figure 1 shows recruitment and participant flow through the study.

A total of 208 residents were available to be recruited to the study. Of this total, 149 residents were recruited with an average age of 85 years (Figure 1). Those not eligible ($n = 33$), were acutely unwell, terminally ill or under the age of 65 years, and 26 refused to take part (response rate 85%). All residents who consented participated in the baseline assessments.

The main demographic variables did not vary between groups (Table 1).

Intervention uptake

All residents in the intervention group $n = 73$ set a goal and participated in the repetitive ADL programme. Just over half the residents in the intervention group achieved their goal during the 6 months $n = 40$. Goals were categorised

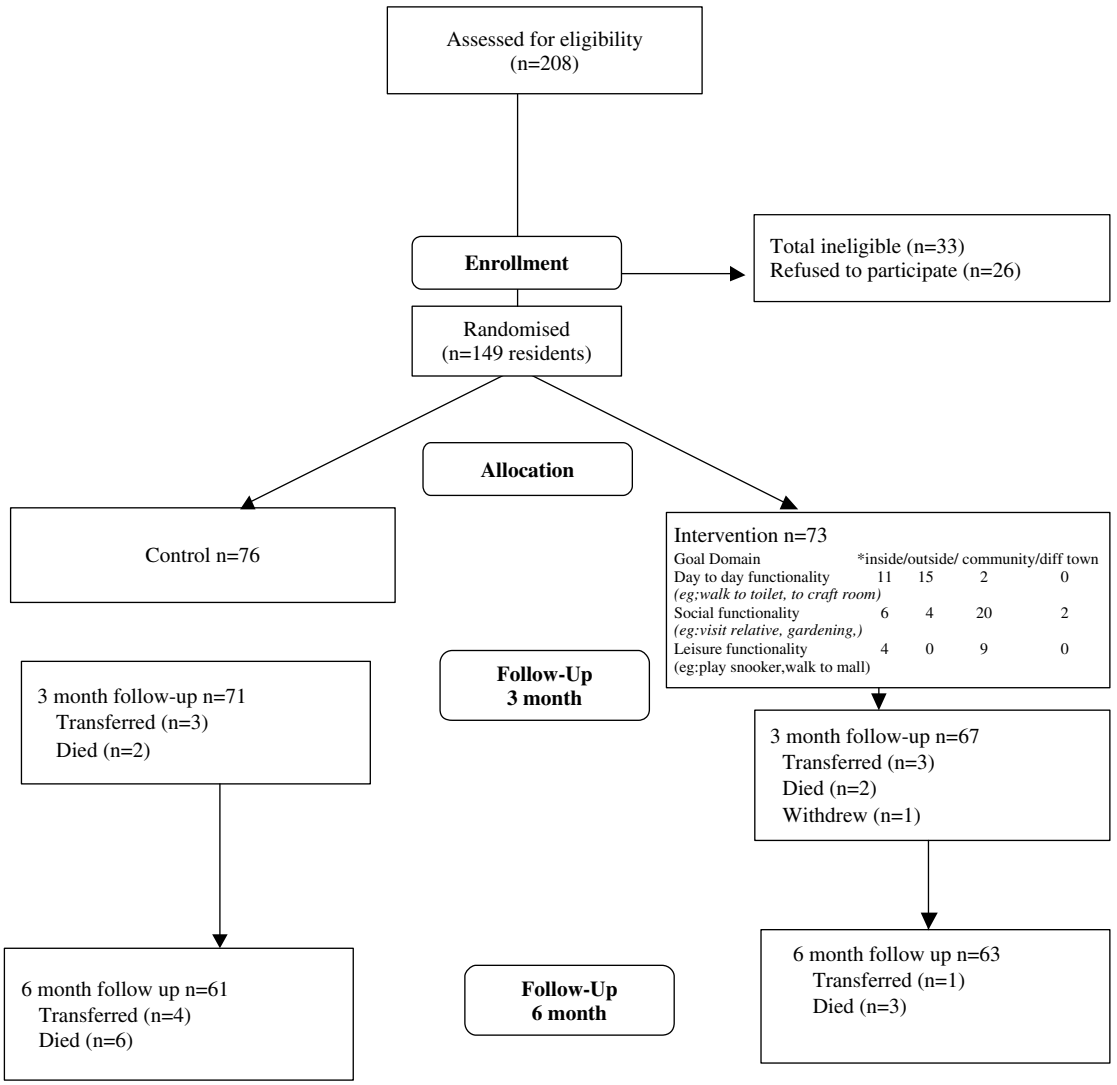

Figure 1. Flow of residents through a trial of an ADL programme. *Denotes location of goal attainment inside facility, in one's own room, dining room, lounge outside facility, within the grounds of the residential care home; community, out in local community or town; different town, other towns within New Zealand, or country, i.e. Australia.

as involving: day-to-day functionality, walk to the toilet or craft room, 28 residents; social functionality, visit relative, gardening 32 residents; leisure functionality, play snooker, walk to the mall, 13 residents. Day-to-day function goals were mostly sited in (11) and around (15) the rest home with 2 in the community. Social functionality goals were usually sited in the community or different town (22) with the minority being in (6) or around (4) the rest home. Leisure functionality goals were split between the community (9) and inside the rest home (4).

Adherence to the intervention was variable. Over half the intervention group completed their programme only once a day rather than twice as prescribed. Conversations with residents indicated that this was related to staffing and other resource factors within the homes, rather than the unwillingness of the residents to participate in the programme.

Observations of research staff indicated that in two homes the control group residents were observed participating in activities with intervention group residents in the lounge or during walking group outings. Ways to minimise this contamination were discussed at the regular review meetings with all staff.

Table 2 shows the results of the outcome analyses. There were no differential changes in observed mobility or life satisfaction with measures, TUG, EMS, LSI-Z between the groups over time. Repeated measures analysis showed a significant improvement in the SF-36 PCS scale score in

Table 1. Demographic and health characteristics of older residential care home residents enrolled in a trial of a programme to promote independence

	Control $n = 76$	Intervention $n = 73$
Age (years) mean (SD)	84.7 (6.7)	86.8 (5.5)
Women *n* (%)	64 (83)	62 (85)
Caucasian *n* (%)	61 (80)	55 (75)
Number of prescribed medications mean (SD)	4.8 (1.8)	4.9 (2.1)
SNL 2*n* (%)	11 (14)	9 (12)
SNL 3*n* (%)	53 (70)	46 (63)
SNL 4*n* (%)	12 (16)	18 (25)
Barthel index score mean (SD)	17.5 (2.7)	17.8 (2.2)
AMTS mean (SD)	7.0 (2.8)	7.0 (2.9)

SD, standard deviation; AMTS, Abbreviated Mental Test Score; range, 0 to 10; greater than 6, normal cognition; SNL, Support need level; a measure of functional ability range 5 (bed-bound and requiring nursing cares daily) to 1 (relatively independent).

the intervention group at 3-months follow-up compared with the control group. This difference was not evident at 6 months. The control group appeared to increase scores in most categories between 3- and 6-months follow-up, thereby lessening the observable difference between the groups.

Adverse events

There was no difference in the frequency of self reported leg pain between the intervention and control groups. Fatigue was reported by 31 and 43% of the intervention and control group respectively $P = 0.182$.

Falls

Fifty-seven per cent (43 of 76) of the control group reported sustaining at least one fall over the intervention period compared to 42% (31 of 73) of the intervention group ($P = 0.127$).

Discussion

This study suggests that an individualised repetitive ADL programme may have improved health status for low-level dependency residential care home residents at least in the short term. The effects of such an intervention are clinically important when considering that many older people in residential care 'hover' close to a 'dependency threshold'. There is a need to increase the functional reserve of older people and activity programmes may be one feasible way to do this.

This study did not show a sustained improvement in health status beyond 3 months. There was evidence of contamination of control group participants in this trial with control group participants being observed taking part in walking groups and exercise classes with the intervention group. This may have significantly influenced their own level of function and well being, thereby lessening the chance of observing an intervention effect, a type 1 error, or failure of the internal validity of the result. Both physical and mental health summary scores of the SF-36 tended to improve in the control arm in the second 3 months of the trial. If this has occurred it may have obscured a potentially larger improvement as a result of the intervention than what was observed. This potential for contamination is common in trials where control and intervention groups were not completely separated [24, 25]. Further trials of programmes where activity programmes are delivered by staff in facilities would be better to randomise facilities, rather than sections of facilities.

This study was acceptable to residents (response rate 85% and low drop number of dropouts) probably because it incorporated moderate intensity functional task type activity into daily activities [8, 13, 26, 27] and it was facilitated by

Table 2. Comparison of outcome measures of older residential care home residents enrolled in a trial of a programme to promote independence

	Group	baseline	3 m	6 m	*P*-value for difference between intervention and control in change over time
TUG	Control	29.9 (2.3)	28.4 (2.4)	29.8 (2.4)	0.85
	Intervention	29.2 (2.4)	27.8 (2.4)	30.2 (2.4)	
EMS	Control	16.2 (0.4)	15.8 (0.4)	15.8 (0.5)	0.31
	Intervention	15.4 (0.4)	15.6 (0.4)	15.1 (0.5)	
LSI-Z	Control	13.9 (0.7)	14.0 (0.7)	14.3 (0.7)	0.99
	Intervention	15.3 (0.7)	15.3 (0.7)	15.7 (0.7)	
SF-36 PCS	Control	40.3 (1.2)	38.8 (1.28)	39.1 (1.3)	0.022
	Intervention	40.1 (1.24)	41.4 (1.3)	39.3 (1.3)	
SF-36 MHCS	Control	53.7 (1.4)	53.0 (1.4)	55.3 (1.5)	0.52
	Intervention	54.9 (1.4)	55.0 (1.4)	55.5 (1.4)	

TUG, Timed-up-and-go score; range, 9–120 s; higher score means lesser mobility; EMS, Elderly Mobility Scale score; range 1–20, higher score indicates greater mobility; LSI-Z, Life Satisfaction Index Score; range 5–26, higher score indicates higher satisfaction with life; SF-36 PCS, SF-36 physical component summary score; SF-36 MHCS, SF-36 mental health component summary score.

an initial personal approach to the individual [3, 5]. Even isolated residents were able to participate, suggesting that dissemination of this programme would be possible.

Recent randomised controlled trials have found inconsistent effects of physical training on physical performance in institutionalised older people. There is evidence to support physical training having a positive impact on muscle strength, aerobic capacity, flexibility and balance [9–11]. Exercises to improve strength, balance and endurance were included in the current programme; however, the intensity may not have been sufficient to result in measurable change in physical performance outcomes. In addition, the mobility measures used may not have been sensitive enough to show small but important changes in physical function. These small changes may have resulted in the observed impact on health status as measured by the SF-36 [9].

To our knowledge, this is one of a few studies to use functional 'goal'-driven task activities, proven in community dwelling older people [13] to improve physical function in residential care. Goal setting is the most influential theory of human motivation [15, 28] and the use of usual activities as exercise acceptable to older people, and has potential for long-term compliance [29].

Workforce issues that have plagued the long-term care industry for a number of decades may have had a major impact on the ability of the care staff to continue the programme in a sustained way [30]. This may have contributed to the slow-down in improvement of the intervention group during the second 3 months of the study. This programme was designed to be sustainable but perhaps needs increased staff involvement for transfer of skills and enthusiasm to have a long-term impact.

Limitations

The sample size in this trial was small and relevant, but important small changes may not have been detectable such as changes in physical function. Further studies with larger sample sizes are required to verify this result. Generalisability of this result is limited by the volunteer participation of the homes. The analysis of this trial could be criticised for conducting multiple comparisons; however, the SF-36 subscales, presented for clarity, contribute to the main outcome, the PCS score. In addition the contamination observed limited internal validity of the study.

In conclusion, maintaining the physical capacity to meet ordinary and unexpected demands of ADL should be the goal for many older people living in residential care. This goal-setting functional exercise programme shows promising results requiring replication and may offer a positive option for those in long-term care facilities.

Acknowledgements

The authors would like to acknowledge the residential care home industry which has contributed financial support: Sue Mellor (deceased, 2004), Michelle Gundersen-Reid assisted in collecting the data: a special acknowledgement to staff and residents who consented to participate in the trial. Review of the manuscript in preparation was provided by Clare Robertson and Stephen Buetow.

Conflicts of interest

There are no conflicts of interest.

Funding source

The Auckland Medical Research Fund (AMRF) and the Auckland University Research Committee supported this project by providing project grants.

Key points

- Older people experience decline in physical activity after entry into residential care.
- Increasing habitual exercise can assist older people in maintaining functional performance.
- This study shows that using a functional 'goal' and an exercise programme that is incorporated into the residents' ADL may be more acceptable to frail older residents in improving their health status.

References

1. Fiatarone-Singh M, Mayer J. Exercise comes of age rationale and recommendations for a geriatric exercise prescription. J Gerontol Med Sci 2002; 57a: M262–82.
2. Rajeski W, Mihalko S. Physical activity and quality of life in older adults. J Gerontol Med Sci 2001; 56A: 23–36.
3. Christmas C, Anderson R. Exercise an older people: guidelines for the clinician. J Am Geriatric Soc 2000; 48: 318–24.
4. Mihalko S, McAuley E. Strength training effects on subjective wellbeing and physical function in the elderly. J Ageing Phys Act 1996; 4: 56–68.
5. King AC, Blair SN, Bild DE *et al.* Determinants of physical activity and interventions in adults. Med Sci Sports Exerc 1992; 24: S221–36.
6. Galloway M, Jokel P. Aging successfully: The importance of physical activity in maintaining health and function. J Am Acad Orthop Surg 2000; 8: 37–44.
7. Ruuskanen J, Parkatti T. Physical activity and related factors among nursing home residents. J Am Geriatr Soc 1994; 42: 987–91.
8. Resnick B. Functional performance and exercise of older adults in long- term care settings. J Gerontol Nurs 2000; March: 7–15.
9. Rydwik E, Frandin K, Akner G. Effects of physical training on physical performance in institutionalised elderly patients (70+) with multiple diagnoses. Age Ageing 2004; 33: 13–23.
10. Morris J, Fiatarone M, Kiely D *et al.* Nursing rehabilitation and exercise strategies in the nursing home. J Gerontol 1999; 54a: M494–5000.
11. Lazowski DA, Ecclestone N, Myers A *et al.* A randomized outcome evaluation of group exercise programs in long term care institutions. J Gerontol 1999; 54A: M621–7.

12. Jensen J, Lundin-Olsson L, Nyberg L *et al*. Fall and injury prevention in older people living in residential care facilities: A cluster randomized trial. Ann Intern Med 2002; 136: 733–41.

13. de Vreede PL, Samson MM, van Meeteren NL *et al*. Functional tasks exercise versus resistance exercise to improve daily function in older women: a feasibility study. Arch Phys Med Rehabil 2004; 85: 1952–61.

14. MCAuley E, Lox C, Duncan T. Long-term maintenance of exercise, self_efficacy, and physiological change in older adults. J Gerontol: Psychol Sci 1993; 48: 218–34.

15. Stenstrom C. Home exercise in rheumatoid arthritis functional class 11: goal setting versus pain attention. J Rheumatol 1994; 21: 627–34.

16. van der Rij A, Miranda G, Laurant M *et al*. Effectiveness of physical activity interventions for older people. Am J Prev Med 2002; 22: 120–33.

17. Friedman L, Furberg C, DeMets D. Fumdamentals of Clinical Trials. 3rd edition New York: Springer, 1998.

18. Hodkinson H. Abbreviated mental test score. Age Ageing 1972; 1: 233–8.

19. Mahoney F, Barthel D. Functional evaluation: The Barthel Index. Md State Med J 1965; 14: 61–5.

20. Smith R. Validation and reliability of the elderly mobility scale. Physiotherapy 1994; 80: 745–7.

21. Podsiadlo D, Richardson S. The timed 'Up and Go' a test of basic functional mobility for frail elderly persons. J Am Geriatr Soc 1991; 39: 142–8.

22. Ware J. The SF-36 Health Survey. In Vol 2000 ed, 1998.

23. Neugarten BL, Havighurst RJ, Tobin S. The measurement of life satisfaction. J Gerontol 1961; 16: 134–43.

24. Elley CR, Kerse N, Chondros P *et al*. Intraclass correlation coefficients from three cluster randomised controlled trials in primary and residential health care. Aust N Z J Public Health 2005; 29: 461–7.

25. Campbell MJ, Grimshaw JM. Cluster randomised trials: time for improvement. BMJ 1998; 317: 1171–2.

26. McMurdo ME, Rennie L. A controlled trial of exercise by residents of old people's homes. Age Ageing 1993; 22: 11–5.

27. Fiatarone M. Fitness and function at the end of life. J Am Geriatr Soc 1995; 43: 1439–40.

28. Mayer J, Jermanovich A. Changes in health behaviours of older adults: the San Diego medicare preventive health project. Prev Med 1994; 23: 127–33.

29. DiPietro L. Physical activity in aging: changes in patterns and their relationship to health and function. J Gerontol A Biol Sci Med Sci 2001; 56: 13–22.

30. Feldman P, Kane R. Practice and management of long-term care. Milbank Q 2003; 81: 179–220.

Received 4 December 2006; accepted in revised form 19 June 2007