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Sit-to-stand as home exercise for mobility-limited adults over 80 years of age—GrandStand System™ may keep you standing?

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Abstract

Purpose to compare the effects of functional home exercise of repeated sit-to-stands with low-intensity progressive resistance training, on performance measures in mobility-limited adults over 80 years of age.
Setting participants' homes.
Design community-dwelling older adults ≥80 years of age were invited to participate in a randomised controlled clinical trial. Baseline and outcome measures were: comfortable gait velocity, 30-s chair-stand test, 15-s step test, Berg Balance Scale, Modified Falls Efficacy Scale and the Late-Life Function and Disability Instrument—function component. Participants randomised to the intervention group performed repeated sit-to-stands using a GrandStand System™; a biofeedback device that recorded and displayed the number of repetitions performed. Participants randomised to the control group performed knee extensions using ankle cuff weights. Both groups performed the exercises daily for 6 weeks.
Results sixty-six older adults took part. The intervention group had a statistically significant improvement in Berg Balance Scale mean score, 1.67 ± 2.64 points, $P = 0.001$ (control group 0.73 ± 3.63 points, $P = 0.258$), indicating an improvement in balance over the 6-week exercise period. There was no statistically significant effect of either intervention on the other outcome measures.
Conclusions in a highly variable population of older adults with mobility limitations, low-intensity functional home exercise of repeated sit-to-stands using the GrandStand System™ improved Berg Balance Scale score while low-intensity progressive resistance training did not. While statistically significant, the improvement in Berg Balance Scale score was modest raising the issue of what extent of change in score is clinically significant in this population.

Keywords: *aged, 80 and over, balance, exercise, physical functioning, elderly*

Introduction

Reduced lower limb strength in the older adult population is associated with diminished ability to perform functional activities [1–4], increased risk of falling, increased risk of experiencing recurrent and more severe falls [5], and increased mortality risk [6]. In healthy older adults, lower limb strength loss may amount to 1–3% per year, and is exacerbated by baseline weakness and sedentary behaviour [7, 8].

Research indicates closely supervised high-intensity progressive resistance training is safe and effective in improving strength and performance in an older population [9]. However, access, transport, and cost to participants or providers may limit the practicality of providing exercise interventions in this form. One solution is to reduce the level of supervision, but this appears to be associated with an increased risk of adverse events [10]. Lower intensities of progressive resistance training may therefore be required for safe unsupervised exercise performance, particularly by the more frail older adults. While lower-intensity home programmes can be effective in improving strength and measures of function [11, 12], some studies have shown equivocal results [9, 13].

Using a functional task to provide a resistance-training stimulus for home exercise has received little attention. Adequate quadriceps strength is required to generate enough knee extension to stand from a seated position without assistance from the upper limbs [14]. For the more frail older adult, repeated sit-to-stands may be sufficiently challenging to improve lower limb strength and reduce functional limitations.

The aim of the current study is to compare 6 weeks of daily home exercise using the GrandStand System™, a device that records and displays the number of repeated sit-to-stands performed, with progressive resistance knee extension exercises using ankle weights. The hypothesis was that the GrandStand System™ protocol would be more effective than the control protocol at improving functional outcome measures, and fear of falling, in community dwelling, mobility-limited adults over 80 years of age.

Study design

This study was a randomised controlled trial, approved by the AUT University Ethics Committee. All participants were advised of the study purpose, procedure and known risks, and gave informed written consent to participate.

Study population

Potential participants were volunteers recruited from the central and North Shore areas of Auckland, New Zealand. Participants were screened for inclusion by telephone. To be eligible for inclusion, interested older adults had to be: 80 years of age or older, able to walk 4 m with or without any aid, sedentary and mobility-limited. The telephone screening included the Short Form-36 Questionnaire physical function component (SF-36 PF-10) [15]. Potential participants were considered to have a mobility limitation if they were limited 'a lot' in vigorous activities and in one or more other activity on the SF-36 PF-10. Potential participants were excluded if: currently receiving physiotherapy treatment, medically unstable, had a medical condition that contraindicated participation in a resistance exercise programme or had a physical condition that prevented them from attempting either exercise protocol.

Participant randomisation and assessment

Participants were randomised by coin toss to either of the two exercise protocols by a researcher not involved in the assessments. One of three independent assessors, all registered physiotherapists who completed training on the assessment process, performed the baseline assessment. The independent assessor who conducted the baseline assessment also administered the outcome assessment at the end of the exercise programme. The independent assessors were unaware of any participant's group allocation and reported if blinding to group allocation was broken.

Baseline and outcome measures

Height, weight, medical history and medication details were obtained at baseline. The independent assessors confirmed that each participant had the cognitive ability to take part in the study from their ability to follow instructions at baseline testing. The baseline and outcome measures used were: comfortable gait velocity (measured over the central 3 m of a 4 m course) [16], 30 s chair stand [17], Berg Balance Scale (BBS) [18–20], 15-s step test [21], and two questionnaires, the Modified Falls Self Efficacy Scale [22] and the Late-Life Function and Disability Instrument—function component [23]. These measures were determined from the literature to be valid and reliable in assessing older adults, and selected as practical to administer in the home setting.

Intervention delivery

After the baseline assessment, the researcher delivered the exercise equipment and instructions to each participant who performed the first day of exercises under supervision. Participants were supervised following the first day of exercises by five telephone calls from the researcher over the 6-week programme. Six weeks and shorter duration resistance and functional exercise programmes have been found to be effective in older adults and adults affected by stroke, respectively [24, 25]. Participants were provided with an exercise diary to record the amount of exercise performed each day, and to note if any falls or adverse events occurred during the programme. Adverse events were determined, at the outset, to be any event that required medical attention, or caused a participant to limit their normal activity for two or more consecutive days. Exercise progress and progression and the details of any falls or adverse events were discussed during each telephone call. To avert unblinding the assessors, the researcher telephoned each participant prior to the post-intervention assessment to remind them not to divulge their group allocation.

Intervention—GrandStand System™ group

The functional task intervention consisted of repeated slow sit-to-stands using a GrandStand System™. The GrandStand System™ is a pressure cushion with a biofeedback monitor attached. The GrandStand System™ was placed on a dining room chair from which the participant performed repeated sit-to-stand exercises. The biofeedback monitor provided a visual display of the number of sit-to-stands as they were performed and kept a daily and cumulative record of the total number performed. Participants allocated to the functional task intervention (the GrandStand System™ group) were instructed to perform the sit-to-stands slowly with as little assistance from their hands as possible. Participants in the GrandStand System™ group started with 10 repetitions and were instructed to increase repetitions by 5 a day or as they were able, until they reached the number of repetitions they were comfortable with to a maximum of 50 sit-to-stands a day.

Control—knee extension group

Participants allocated to the control group (the knee extension group) performed low-intensity knee extension exercises using adjustable ankle cuff weights. The knee extensions were performed once daily, with all participants in the knee extension group starting with a single set of 10 repetitions using no weight, taking approximately 8 s to complete each repetition. Participants progressed the exercises by increasing load and repetitions as they were able, to a maximum of 2 sets of 10 repetitions and 4 kg in weight.

Statistical analysis

Analysis was on an intention-to-treat basis, and any data missing at the end of the programme was replaced by the participant's baseline test values. A sample size of 33 participants in each group was projected to provide a power of 80% at 5% alpha level to detect a 20% improvement in sit-to-stand performance. This calculation was based on a normative score in this population of approximately 12 ± 4 repetitions for the 30-s chair-stand test [26].

Raw Late-Life Function and Disability Instrument scores were transformed into scaled scores prior to data analysis [23]. All analyses were conducted using SPSS 14.0 for Windows (SPSS Inc, 2005). Independent sample t-tests were used to assess any difference between the GrandStand System™ group and knee extension group at baseline, and any between-groups change in difference scores following the final assessment. Paired samples t-tests were used to assess the difference between baseline and outcome measures within each group. Statistical significance was accepted if the 2-tailed P value was ≤ 0.05.

Declaration of sources of funding

Funding for this study was obtained from the developer of the GrandStand System™ and from AUT University, Auckland, New Zealand. The financial sponsors played no role in the design, execution, analysis and interpretation of data or in writing the study for publication.

Results

Participants

The 66 participants' demographic, health and mobility characteristics are presented in Table 1. The randomisation process appears to have been effective as participants with varying levels of mobility limitation were distributed between the groups, 18.2% of all participants were limited 'a lot' in the minimum two activities, most (59.1%) were limited 'a lot' in five or more activities.

There were no significant differences between the groups on any characteristic or performance measure at baseline. Tests of normality showed that the baseline data followed normal distribution. The large standard deviations for each participant characteristic and baseline measure indicate wide variability within the study population.

Figure 1 outlines the flow of participants through the study. Two participants were excluded at baseline assessment following randomisation; one was excluded due to cognitive problems identified when the participant was unable to perform the baseline assessments, the other due to significant visual impairment preventing them reading the

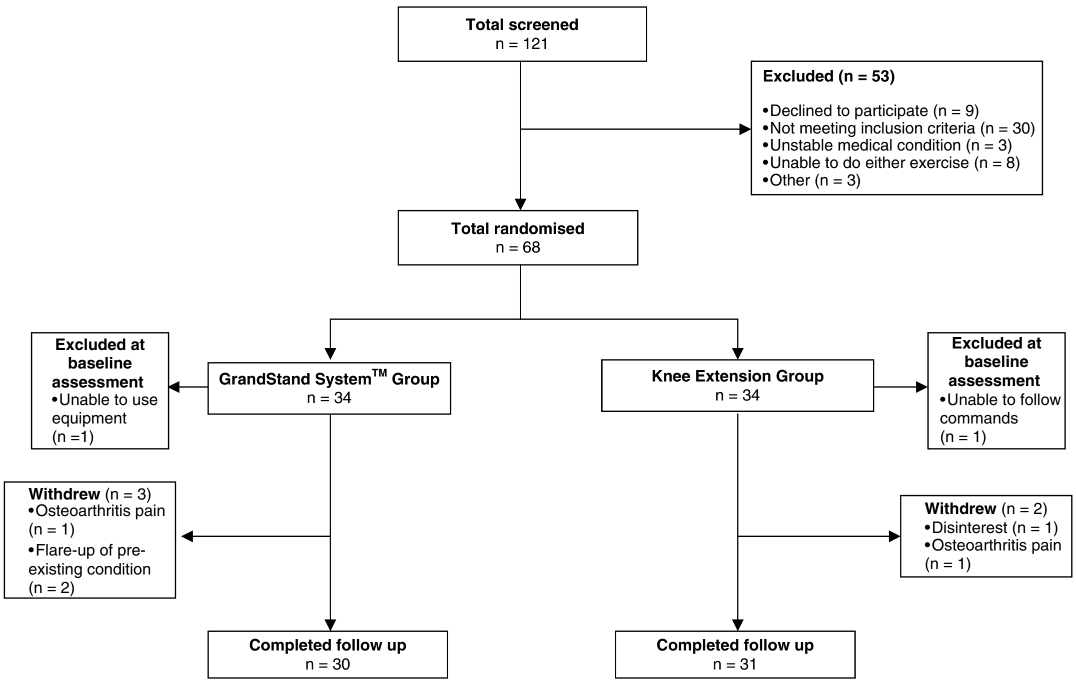

Figure 1. Flow of participants through the study.

Table 1. Demographic, health and mobility characteristics of participants at baseline

Characteristics		All ($n = 66$)	GrandStand System™ group ($n = 33$)	Knee extension group ($n = 33$)	Comparison of means $P \leq 0.05$
Gender M:F Number (%)		19 (28.8) : 47 (71.2)	10 (30.3) : 23 (69.7)	9 (27.3) : 24 (72.7)	n/a
Age (years) Mean ± SD (minimum, maximum)		85.2 ± 3.6 (80, 93)	85.2 ± 3.2 (80, 92)	85.1 ± 4.0 (80, 93)	0.89
Height (cm) Mean ± SD (minimum, maximum)		162.2 ± 9.2 (140, 183)	161.7 ± 9.4 (140, 183)	162.6 ± 9.2 (146, 183)	0.69
Weight (kg) Mean ± SD (minimum, maximum)		68.0 ± 13.7 (40, 95)	68.1 ± 13.5 (42, 95)	67.8 ± 14.0 (40, 95)	0.94
BMI (kg/m^2) Mean ± SD (minimum, maximum)		25.8 ± 5.1 (17.1, 41.7)	26.1 ± 5.8 (17.1, 41.7)	25.5 ± 4.4 (18.3, 37.1)	0.64
SF36 PF-10 (activities 'limited a lot')	2	12 (18.2)	7 (21.2)	5 (15.2)	—
Number (%)	3	6 (9.1)	4 (12.1)	2 (6.1)	
	4	9 (13.6)	4 (12.1)	5 (15.2)	
	5+	39 (59.1)	18 (56.4)	21 (63.6)	
Psychotropic medications	0	52 (78.8)	25 (75.8)	27 (81.8)	—
Number (%)	1	10 (15.2)	6 (18.2)	4 (12.1)	
	2	4 (6.1)	2 (6.1)	2 (6.1)	
Falls in previous 12 months	0	42 (63.6)	20 (60.6)	22 (66.7)	—
Number (%)	1	15 (22.7)	8 (24.2)	7 (21.2)	
	2	5 (7.6)	4 (12.1)	1 (3.0)	
	3+	4 (6.1)	1 (3)	3 (9.1)	
Health conditions	Cancer	10 (15.2)	3 (9.1)	7 (21.2)	—
Number (%)	Cardiovascular	21 (31.8)	11 (33.3)	10 (30.3)	
	Diabetes (NIDDM)	5 (7.6)	2 (6.1)	3 (9.1)	
	Gastrointestinal	13 (19.7)	9 (27.3)	4 (12.1)	
	Hypertension	20 (30.3)	10 (30.3)	10 (30.3)	
	Musculoskeletal	23 (34.8)	10 (30.3)	13 (39.4)	
	Neurological	8 (12.1)	3 (9.1)	5 (15.2)	
	Osteoarthritis lower limb	28 (42.4)	13 (39.4)	15 (45.5)	
	Rheumatic—other	16 (24.2)	7 (21.1)	10 (30.3)	
	Respiratory	14 (21.2)	9 (27.3)	5 (15.2)	
	Renal	5 (7.6)	2 (6.1)	3 (9.1)	
	Vestibular	5 (7.6)	4 (12.1)	1 (3.0)	

GrandStand System™ monitor or completing the exercise diary independently. Blinding was inadvertently broken in respect of one participant when the assessor was shown a community newspaper article featuring a photograph of the participant performing the allocated exercise.

Intervention effect

Table 2 presents the pre- and post-intervention data. There was no significant between-group difference in results for any of the outcome measures used. However, the GrandStand System™ group did have a significant within-group improvement in BBS score over the course of the programme, mean improvement 1.67 ± 2.64 points, $P = 0.001$, compared to the knee extension group 0.73 ± 3.63 points, $P = 0.258$. There was no within-group effect of either intervention on any other outcome measure.

Withdrawals

Five participants, representing less than 10% of the study population, withdrew from the study. Three withdrew from the GrandStand System™ group; two following flare-up of pre-existing medical conditions (lower back pain and idiopathic leg pain) and one due to knee pain from osteoarthritis. Two participants withdrew from the knee extension group, one due to disinterest and the other due to knee pain from osteoarthritis. There were no significant differences in participant characteristics or performance measures at baseline between the five participants who withdrew and those who completed the study. Of the five who withdrew, one was available to perform the final assessment. Results from the baseline assessments for the other four participants who withdrew have been inserted in place of their missing data for analysis purposes.

Table 2. Outcome variables at baseline and outcome assessment—within-group and between-group differences

	GrandStand System™ group			Knee extension group			Difference scores		
	Pre	Post	Within group $P \leq 0.05$	Pre	Post	Within group $P \leq 0.05$	GrandStand System™ group	Knee extension group	Between groups $P \leq 0.05$
Comfortable gait speed (m/s)	0.63 ± 0.18 (0.57–0.7)	0.64 ± 0.18 (0.57–0.7)	0.894	0.63 ± 0.20 (0.56–0.7)	0.65 ± 0.23 (0.57–0.77)	0.577	0.002 ± 0.16	0.02 ± 0.12	0.702
Chair stand (repetitions)	6.33 ± 3.71 (5.02–7.65)	6.39 ± 3.5 (5.15–7.63)	0.935	5.48 ± 4.4 (3.94–7.03)	5.64 ± 4.58 (4.01–7.26)	0.443	0.06 ± 2.59	0.15 ± 1.54	0.863
Step test (repetitions)	13.36 ± 5.63 (11.37–15.36)	14.36 ± 7.61 (11.66–17.07)	0.271	14.67 ± 5.70 (12.64–16.69)	15.82 ± 7.80 (13.05–18.58)	0.184	1.0 ± 5.13	1.15 ± 4.87	0.902
Berg Balance Scale (/56)	45.88 ± 6.55 (43.56–48.2)	47.55 ± 6.48 (45.25–49.84)	0.001	46.45 ± 6.35 (44.2–48.7)	47.18 ± 6.23 (44.97–49.39)	0.258	1.67 ± 2.64	0.73 ± 3.63	0.233
Modified Falls Efficacy Scale (/14)	8.05 ± 1.70 (7.45–8.66)	7.91 ± 1.73 (7.3–8.53)	0.393	8.44 ± 1.66 (7.85–9.02)	8.36 ± 1.44 (7.85–8.87)	0.726	−0.14 ± 0.93	−0.08 ± 1.25	0.818
Late-Life Function and Disability Instrument (/100)	49.67 ± 6.98 (47.2–52.15)	49.72 ± 7.11 (47.23–52.27)	0.886	51.33 ± 7.97 (48.5–54.16)	50.71 ± 8.09 (47.84–53.58)	0.357	0.08 ± 3.17	−0.62 ± 3.84	0.420

Mean ± SD (95% confidence interval)

Adverse events

During the study, five participants fell: two in the GrandStand System™ group and three in the knee extension group. One participant from the knee extension group fell on two occasions and required medical attention following each fall. None of the falls were during or attributed to the exercises.

Three participants in each group experienced adverse events attributed to the exercises; all were pain or discomfort that prevented them performing their normal activities for two or more days. No participant reported requiring medical attention. In addition, four participants in each group reported discomfort that did not affect their normal daily activities but resulted in them not performing the exercises on some days.

Adherence

Both groups performed exercises a mean 31 out of the 42 possible exercise days, but there was no significant difference in mean adherence between the groups, $P = 0.948$. Sixty-six percent of the participants in the GrandStand System™ group exercised in excess of 80% of the possible exercise days; the figure is slightly less in the knee extension group at 60.6% for the same level of adherence.

Discussion

This study showed that 6 weeks of home-based training using the functional activity of sit-to-stand improves BBS score, while low-intensity knee extension exercise does not. Neither exercise protocol significantly altered any other outcome measure used. Levels of adverse events and adherence were similar between the two groups.

In the absence of any significant between-groups differences at final assessment, the hypothesis must be acknowledged as not proven; however, there are still valuable conclusions that can be drawn from the study. This study is important in that it suggests a short period of minimally supervised functional exercise at home can lead to quantifiable improvements in a functional balance measure. The degree of improvement in BBS score is similar to that found following 6 months of high-intensity supervised group functional training [27]. This study is also important in that it compares a simple functionally based exercise (GrandStand System™) with a traditionally prescribed exercise (leg extensions), and is the first study we have been able to identify that has done this in the home.

Sit-to-stand is a whole body action, requiring postural control and other sensorimotor systems in addition to adequate strength [28]. It is, therefore, not surprising that repetitions of sit-to-stand had a positive effect on a balance outcome measure over time, while a seated strengthening programme for one muscle group did not. Comparable results have been found in other home exercise studies in this population. Ten weeks of knee extensions performed at high intensity did not improve BBS score [10], while a year's programme of low intensity, whole-body strength and balance exercises significantly increased the balance outcome measure used [29].

The improvement in BBS score in the current study, while statistically significant, raises the question of what constitutes clinically important change in BBS score in this participant population. An increase of 5–7 points is cited as required to be confident of improved performance, this was calculated in people over 65 years of age following acute stroke [30]. Much smaller changes in BBS score have been predicted to impact falls risk [31, 32]. As BBS score appears to stay stable over time [20], the small improvements resulting from functional training as found in the present study may be clinically significant in representing reduced falls risk.

There are a number of limitations noted with this study. Whilst an intention-to-treat approach reduces the effect of any dropout bias by replacing missing data with baseline measures, it assumes that participants would have maintained their baseline ability over the course of the programme. Calculating one repetition-maximum (1RM) would have provided an objective measure of baseline strength capacity, and increased confidence that the exercise intensity was adequate. It should be noted that prediction equations using 1RM have been validated in younger older adults using weights machines, not free weights [33]. Long-term follow-up and a non-intervention control group would have identified changes over time with and without intervention, and any impact on falls. Funding limitations did not permit the study to be expanded in this way.

Study strengths

Broad inclusion criteria meant the participants were highly variable in characteristics and baseline results, providing a representative group of community-dwelling older adults. In addition, due to pragmatic protocols and intervention delivery, the results reflect what would occur if the intervention was performed in the community. By following the CONSORT guidelines for randomised controlled trials, the results are more able to be generalised, and useful for drawing clinical recommendations based on a single intervention as home exercise.

Conclusion

Six weeks of home exercise of daily sit-to-stands using the GrandStand System™ improved BBS score, but not other outcome measures. The same duration of low-intensity progressive resistance training had no effect on any outcome measure. The degree of improvement in BBS score associated with clinically significant improvement in ability and function has yet to be determined in this population of mobility-limited community-dwelling adults over 80 years of age. This small improvement in BBS score following the GrandStand System™ intervention may, however, represent a clinically relevant improvement in balance.

Conflicts of Interest Declaration

No conflicts of interest arose during the course of this study.

Key points

- Short-duration home sit-to-stand exercises using the GrandStand System™ improved BBS score but not other performance measures.
- Low-intensity knee extension exercises had no significant effect on any outcome measure.
- The degree of improvement in BBS score in the GrandStand System™ group was modest.
- Clinically significant improvement in BBS score is yet to be identified in community-dwelling older adults.

Sources of Support

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References

1. Brill PA, Macera CA, Davis DR, Blair SN, Gordon N. Muscular strength and physical function. Med Sci Sports Exerc 2000; 32: 412–6.
2. Lauretani F, Russo CR, Bandinelli S *et al.* Age-associated changes in skeletal muscles and their effect on mobility: an operational diagnosis of sarcopenia. J Appl Physiol 2003; 95: 1851–60.
3. Purser JL, Pieper CF, Poole C, Morey M. Trajectories of leg strength and gait speed among sedentary older adults: Longitudinal pattern of dose response. J Gerontol 2003; 58A: 1125–34.
4. Salem GJ, Wang MY, Young JT, Marion M, Greendale GA. Knee strength and lower- and higher-intensity functional performance in older adults. Med Sci Sports Exerc 2000; 32: 1679–84.
5. Moreland JD, Richardson JA, Goldsmith CH, Clase CM. Muscle weakness and falls in older adults: A systematic review and meta-analysis. J Am Geriatr Soc 2004; 52: 1121–9.
6. Laukkanen P, Heikkinen E, Kauppinen M. Muscle strength and mobility as predictors of survival in 75-84-year-old people. Age Ageing 1995; 24: 468–73.
7. Doherty TJ. Invited review: Aging and sarcopenia. J Appl Physiol 2003; 95: 1717–27.
8. Frontera WR, Hughes VA, Fielding RA, Fiatarone MA, Evans WJ, Roubenoff R. Aging of skeletal muscle: a 12-yr longitudinal study. J Appl Physiol 2000; 88: 1321–6.
9. Seynnes O, Fiatarone Singh MA, Hue O, Pras P, Legros P, Bernard PL. Physiological and functional responses to low-moderate versus high-intensity progressive resistance training in frail elders. J Gerontol A Biol Sci Med Sci 2004; 59: 503–9.
10. Latham NK, Anderson CS, Lee A, Bennett DA, Moseley A, Cameron ID. A randomized, controlled trial of quadriceps resistance exercise and vitamin D in frail older people: the Frailty Interventions Trial in Elderly Subjects (FITNESS). J Am Geriatr Soc 2003; 51: 291–9.
11. Chandler JM, Duncan PW, Kochersberger G, Studenski S. Is lower extremity strength gain associated with improvement in physical performance and disability in frail, community-dwelling elders? Arch Phys Med Rehabil 1998; 79: 24–30.
12. Jette AM, Lachman M, Giorgetti MM *et al.* Exercise–it's never too late: the strong-for-life program. Am J Public Health 1999; 89: 66–72.
13. McMurdo ME, Johnstone R. A randomized controlled trial of a home exercise programme for elderly people with poor mobility. Age Ageing 1995; 24: 425–8.
14. Hughes MA, Myers BS, Schenkman ML. The role of strength in rising from a chair in the functionally impaired elderly. J Biomech 1996; 29: 1509–13.
15. Lyons RA, Perry HM, Littlepage BN. Evidence for the validity of the Short-form 36 Questionnaire (SF-36) in an elderly population. Age Ageing 1994; 23: 182–4.
16. Worsfold C, Simpson JM. Standardisation of a three metre walking test for elderly people. Physiotherapy 2001; 87: 125–32.
17. Jones CJ, Rikli RE, Beam WC. A 30-s chair-stand test as a measure of lower body strength in community-residing older adults. Res Q Exerc Sport 1999; 70: 113–9.
18. Berg K, Wood-Dauphinee SL, Williams JI. The balance scale: reliability assessment with elderly residents and patients with an acute stroke. Scand J Rehabil Med 1995; 27: 27–36.
19. Berg KO, Maki BE, Williams JI, Holliday PJ, Wood-Dauphinee SL. Clinical and laboratory measures of postural balance in an elderly population. Arch Phys Med Rehabil 1992; 73: 1073–80.
20. Berg KO, Wooddauphinee SL, Williams JI. Measuring balance in the elderly–validation of an instrument. Can J Public Health 1992; 83: S7–S11.
21. Hill KD, Bernhardt J, McGann AM, Maltese D, Berkovits D. A new test of dynamic standing balance for stroke patients: reliability, validity and comparison with healthy elderly. Physiother Can 1996; 48: 257–62.
22. Hill KD, Schwarz JA, Kalogeropoulos AJ, Gibson SJ. Fear of falling revisited. Arch Phys Med Rehabil 1996; 77: 1025–9.
23. Haley SM, Jette AM, Coster WJ *et al.* Late life function and disability Instrument: II. Development and evaluation of the function component. J Gerontol A Biol Sci Med Sci 2002; 57: M217.
24. Cavani V, Mier CM, Musto AA, Tummers N. Effects of a 6-week resistance-training program on functional fitness of older adults. J Aging Phys Act 2002; 10: 443–52.
25. Dean CM, Richards CL, Malouin F. Task-related circuit training improves performance of locomotor tasks in chronic stroke: A randomized, controlled pilot trial. Arch Phys Med Rehabil 2000; 81: 409–17.
26. Bohannon RW. Quantitative testing of muscle strength: Issues and practical options for the geriatric population. Top Geriatr Rehabil 2002; 18: 1–17.
27. Rosendahl E, Lindelof N, Littbrand H *et al.* High-intensity functional exercise program and protein-enriched energy supplement for older persons dependent in activities of daily living: A randomised controlled trial. Aust J Physiother 2006; 52: 105–13.
28. Lord SR, Murray SM, Chapman K, Munro B, Tiedemann A. Sit-to-stand performance depends on sensation, speed, balance, and psychological status in addition to strength in older people. J Gerontol A Biol Sci Med Sci 2002; 57: M539–43.

29. Campbell AJ, Robertson MC, Gardner MM, Norton RN, Tilyard MW, Buchner DM. Randomised controlled trial of a general practice programme of home based exercise to prevent falls in elderly women. BMJ 1997; 315: 1065–9.
30. Stevenson TJ. Detecting change in patients with stroke using the Berg Balance Scale. Aust J Physiother 2001; 47: 29–38.
31. Hess JA, Woollacott M. Effect of high-intensity strength-training on functional measures of balance ability in balance-impaired older adults. J Manipulative Physiol Ther 2005; 28: 582–90.
32. Shumway-Cook A, Baldwin M, Polissar NL, Gruber W. Predicting the probability for falls in community-dwelling older adults. Phys Ther 1997; 77: 812–9.
33. Knutzen KM, Brilla LR, Caine D. Validity of 1RM prediction equations for older adults. J Strength Cond Res 1999; 13: 242–6.

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Prevalence and symptomatology of depression in older people living in institutions in England and Wales

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Abstract

Background Epidemiological studies have shown that depression is common in institutional settings. However, the symptomatology of depression in this group has not been compared to those living in the community.
Aims To estimate the prevalence of depression and depressive symptomatology in participants living in institutions and compare these to people living in other settings.
Method The Medical Research Council Cognitive Function and Ageing Study (MRC CFAS) is a population-based cohort comprising 13,004 individuals aged 65 and above, from five sites across England and Wales. Following screening, a stratified random sub-sample of 2,640 participants received the Geriatric Mental State (GMS) examination of whom 340 resided in institutions. Diagnoses of depression were made using the Automated Geriatric Examination for Computer-assisted Taxonomy system (AGECAT; [1]).
Results The prevalence of depression in those living in institutions was 27.1% (95% CI 17.8–36.3) compared to 9.3% (95% CI 7.8–10.9) in those living at home. Symptoms relating to depressed mood, severity of illness (e.g. wishing to be dead, future looking bleak) and some non-specific symptoms were more common in those living in residential homes. Depression was significantly associated with younger age ($P = 0.002$) and high functional disability ($P = 0.009$) in those living in institutions.
Conclusions Consistent with previous estimates, depression was highly prevalent in institutions, particularly in younger individuals with severe functional impairment. Those in institutions report considerably more symptoms of depression. Finding interventions which address these symptoms might improve quality of life for people in institutions, irrespective of formal diagnoses.

Keywords: *depression, prevalence, geriatric psychiatry, homes for the aged, multi-centre study, elderly*