Age and Ageing 2010; **39:** 169–175
doi: 10.1093/ageing/afp247
Published electronically 21 January 2010

SYSTEMATIC REVIEWS

Is physical rehabilitation for older people in long-term care effective? Findings from a systematic review

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Abstract

Objective: to determine the effects of physical rehabilitation for older people resident in long-term care.
Design: systematic review of randomised controlled trials.
Data sources: The Cochrane Central Register of Controlled Trials, Medline, EMBASE, AMED, CINAHL, PEDro, British Nursing Index, ASSIA, IBSS, PsychINFO, DARE, HMIC, NHS EED, HTA, Web of Science, AsLib Index to UK Theses and Dissertation Abstracts, the National Research Register, Medical Research Council Register, CRIB, Current Controlled Trials and HSRPRoj.
Trials: all randomised trials investigating physical rehabilitation for people permanently resident in long-term care aged ≥60 years. The primary outcome was measures of activity restriction.
Results: 49 trials were identified involving 3,611 subjects with an average age of 82 years. Intervention duration was typically 12 weeks with a treatment intensity of three 30-min sessions per week. Exercise was the main component of the interventions. The mean attendance rate for 17 studies was 84% (range 71–97%). Thirty-three trials, including the nine trials recruiting over 100 subjects, reported positive findings, mostly improvement in mobility but also strength, flexibility and balance.
Conclusion: physical rehabilitation for older people in long-term care is acceptable and potentially effective. Larger scale studies are needed to confirm the findings and should include longer term follow-up and assessment for possible harms.

Keywords: *rehabilitation, long-term care, older people, systematic review, elderly*

Introduction

Populations worldwide are ageing. The proportions of people aged >65 years are anticipated to increase globally from 6.6 to 10% between 1997 and 2025 [1]. This represents an additional 800 million older people. One consequence of this demographic change is a further increase in demand for long-term care. In 2001 there were 142,500 nursing home and 260,066 residential care home places for older people in England [2]. Similarly, in 1997 there were 1,465,000 US nursing home residents, expected to more than double to 3 million by 2030 [3].

Residents in long-term care are characterised by high levels of dependency. A survey of 15,483 residents in 244 UK long-term care facilities reported that 76% required assistance with mobility or were immobile, and 78% had some form of mental impairment [4]. Long-term care residents wish to maintain their health, including functional abilities, and physical rehabilitation may be one widely applicable means of achieving this. Evidence from a UK survey suggests low contact rates for nursing home residents with rehabilitation services [5]. One reason for this might be a perception of lack of effect of rehabilitation for dependent people with multiple long-term conditions. This review examines the evidence available about physical rehabilitation interventions for older people in long-term care. This review is based on the full Cochrane review published in the Cochrane Database of Systematic Reviews in The Cochrane Library [6].

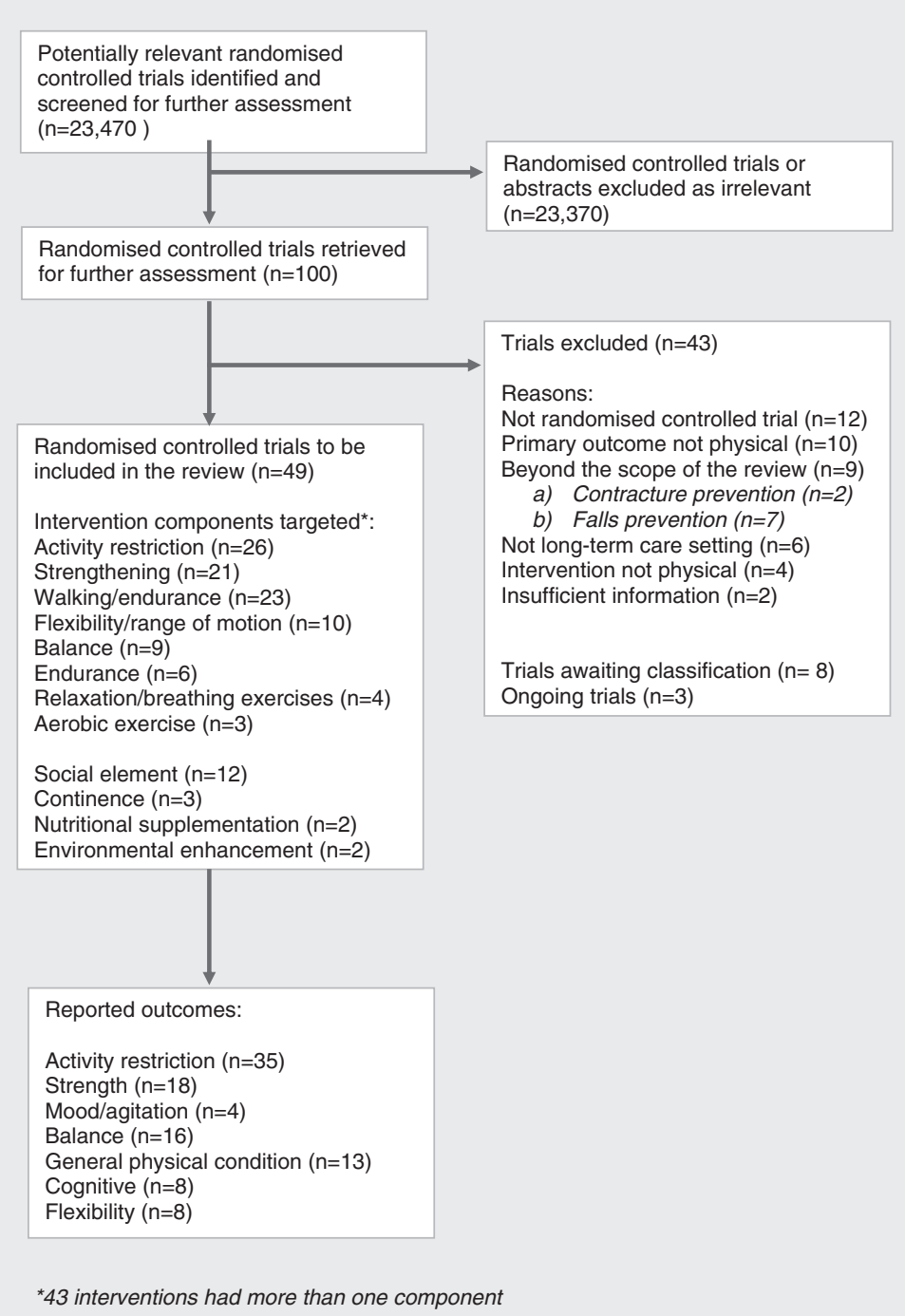

Figure 1. QUORUM trial flow diagram.

Methods

Search strategy and selection criteria

The Cochrane Central Register of Controlled Trials (Cochrane Library 2007 issue 3) and the following databases were searched for all available years until October 2007 without language restrictions (detailed in Appendix A available at *Age and Ageing* online.): Medline, EMBASE, AMED, CINAHL, PEDro, British Nursing Index, ASSIA, IBSS, PsychINFO, DARE, HMIC, NHS EED, HTA, Web of Science and AsLib Index to UK Theses and Dissertation Abstracts. Studies still in progress were identified using the National Research Register, Medical Research Council Register, CRIB, Current Controlled Trials and HSRPRoj. This was supplemented with hand searching of journals and conference proceedings of particular interest.

Randomised controlled trials investigating the outcomes of 'physical rehabilitation' (defined as an intervention in-

Table 1. Characteristics of included studies

Study	Intervention	Delivery	Treatment intensity	Treatment duration	Main findings
Alessi (1999) USA (n = 29)	Functional incidental training. Sleep intervention	Research staff	× 4 per day (maximum of 20 per week)	14weeks	No effect on physical function including mobility. Significant sleep benefits and reduction in agitation
Au-Yeung (2002) Hong Kong (n=31)	'Mobility exercise'—muscle strengthening and balance training	Physiotherapist alone or 2 trainee physiotherapists	45 minutes × 3 per week	2months	Mobility effects unclear, possible benefits in balance
Baum (2003) USA (n = 20)	Seated range of motion and strengthening exercises	Exercise physiologist and care staff	60 min × 3 per week	12months	Mobility including speed of chair rising, strength and balance improved
Bautmans (2005) Belgium (n = 24)	Vibration and static strengthening exercises	N/R	× 3 per week	6weeks	Mobility including speed of chair rising, flexibility and balance improved
Brill (1998) USA (N = 16)	Static muscle trengthening	Exercise instructor	30 min × 3 per week	8weeks	Mobility and strength improved, effects unclear
Brown (2004) USA (n=66)	Indoor gardening	Research staff	20 min × 1 per week	5weeks	Function and mobility improved including speed of chair rising
Bruunsgaard (2004) Denmark (n=39)	Seated leg strengthening exercises	Physiotherapist	45 min × 3 per week	12weeks	Muscle strength improved
Bruyere (2005) Belgium (n=42)	Vibration, balance and strengthening exercises	Physical therapist	10 min × 3 per week	6weeks	Mobility including speed of chair rising, gait and balance improved, benefits in mood and socialisation
Buettner (1997) USA (n=66)	Therapeutic enhancement of nursing care and recreational activities	Therapeutic recreation specialists	'Throughout day and evening'	30weeks	Function, strength, flexibility and mobility improved
Choi (2005) South Korea (n=68)	Sun-style Tai Chi	Certified Tai Chi exercise leader	35 min × 3 per week	12weeks	Mobility, balance, strength and flexibility improved, reduced fear of falling
Clark (1975) USA (n = 23)	Static muscle strengthening and functional exercises	Physical therapist and assistant	60 min × 5 per week	12weeks	No significant effects, including function, possible benefits to balance
Cott (2002) Canada (n=86)	'Walking and talking'	Research assistant	30 min × 5 per week	16weeks	No clear effects in mobility, function or other outcomes
Crilly 1989 Canada (n=50)	Exercises to improve breathing, strength, flexibility, coordination, single and double limb balance and relaxation	Physiotherapists	15–35 min × 3 per week	12weeks	No effect on postural sway, no benefits in mobility
DeKuiper (1993) USA (n = 28)	Materials or imagery or repeated exercise regimes	Occupational therapist	N/A	N/A	Greatest repetitions with materials-based exercises
Faber (2006) Netherlands (n = 278)	Functional walking or Tai Chi-derived balance exercises	Qualified instructor and assistant	90 min up to × 2 per week	20weeks	Function and mobility improved in both groups
Fiatarone (1994) USA (N = 100)	Progressive resistance exercises of hip and knee	Therapeutic recreation specialist	45 min × 3 per week	10weeks	Mobility including speed and stair climbing and strength improved
Gillies (1999) UK (n = 20)	4 functional and 2 stretching exercises	N/R	× 2 per week	12weeks	Mobility improved including distance and speed
Hruda (2003) Canada (n=30)	Leg strengthening exercises	N/R	20–60 min × 3 per week	10weeks	Function, mobility (distance and speed) and muscle power improved
Karl (1982) USA (n = 19)	Upper and lower limb range of movement exercises	N/R	30 min × 2 per week	4weeks	No clear effects including function, possible mood and socialisation benefits
Kinion (1993) USA (n = 24)	Seated range of movement exercises	'Para-professional' caregivers	30 min × 3 per week	8weeks	Improvement in joint movement
Lang (1992) USA (n = 15)	Materials-based or imagery-based, or repeated exercises	Research assistant	N/A	N/A	Greatest repetitions with materials-based exercises
Lazowski (1999) Canada (n=96)	Walking, strengthening and balance exercises	Recreation staff, aides and volunteers	45 min × 3 per week	4months	Mobility including speed of chair rising, balance, flexibility and strength improved, no effects on function

Table 1. (*Continued*)

Study	Intervention	Delivery	Treatment intensity	Treatment duration	Main findings
MacRitchie (2001) USA (*n*=88)	Standing and walking exercises and social attention	Employee volunteers	20 min × 5 per week	4 months	Significant improvement in functional mobility including speed of chair rising, balance and strength
McMurdo (1993) UK (*n*=49)	Arm and leg seated range of movement exercises	Research physiotherapist	45 min × 2 per week	7 months	Function, flexibility and strength improved
McMurdo (1994) UK (*n*=65)	Arm and leg seated range of movement exercises	Research physiotherapist	45 min × 2 per week	6 months	Strength improved, no clear effects
Meuleman (2000) USA (*n*=78)	Progressive resistance and endurance training	Physiotherapist and aide	30 min endurance × 2 per week, resistance training × 3 per week	4–8 weeks	Function, mobility, endurance and strength improved, reduced use of aids
Mihalko (1996) USA (*n*=58)	Seated upper-body high-intensity strength training	Exercise specialist	30 min × 3 per week	8 weeks	Strength and function improved
Morris (1999) USA (*n*=468)	(a) Progressive resistance training and (b) personalised ADL rehabilitation	(a) Staff, family, volunteers (b) Nursing assistants	(a) 20 min × 3 per week (b) As necessary	10 months	Significantly lower rate of functional decline, benefits to mobility and endurance, deterioration in balance
Mulrow (1994) USA (*n* = 194)	One-to-one, incremental physical therapy exercises	One of six therapists	30–45 min × 3 per week	4 months	'Modest' mobility benefits, reduced use of aids, no clear effects on function or flexibility or balance
Naso (1990) USA (*n* = 15)	Endurance exercise programme	N/R	2–15 min × 3 per week	1 year	No significant effects on mobility or other outcomes
Ouslander (2005) USA (*n* = 107)	Individualised, functionally orientated endurance and strength training	Trained research staff	4 × a day × 5 days per week	8 weeks	Endurance, mobility including speed and chair rising, and strength improved but not function
Pomeroy (1993) UK (*n* = 24)	Movement exercises and mobility training	Physiotherapist	30 min × 3 per week	15 weeks	Mobility improved
Przybylski (1996) Canada (*n* = 115)	Enhanced physical and occupational therapy programme	Physiotherapist and occupational therapist	N/R	2 years	Function improved
Riccio (1990) USA (*n*=30)	Imagery to encourage exercise	Researcher	N/A	N/A	More repetitions with imagery
Rosendahl (2006) Sweden (*n* = 191)	High-intensity functional exercises	2 physiotherapists and 1 occupational therapist	45 min × 5 per week	13 weeks	Mobility including speed and strength improved
Sackley (2006) UK (*n* = 118)	Occupational therapy to improve independence	Experienced occupational therapist	Individually determined	Offered over a 3-month period	Less functional deterioration
Sauvage (1992) USA (*n* = 14)	Progressive resistance training of legs and aerobic conditioning	N/R	45–75 min × 3 per week	12 weeks	Mobility, including speed, strength, balance and endurance improved
Schnelle (1995) USA (*n*=94)	Functional incidental training: transfer, standing and walking exercises	Research staff	4 sessions per day	8 weeks	Mobility improved, including greater speed, distance and endurance
Schnelle (1996) USA (*n*=97)	Mobility, endurance and strengthening exercises	Research staff	Maximum of 20 min 3 sessions per week	9 weeks	Improved measure of safety, flexibility, mobility including speed, strength and endurance
Schnelle (2002) USA (*n* = 256)	Walking or sit-to-stands, or propelling wheelchair	Research staff	Every 2 h from 8am to 4pm 5 days per week	8 weeks	Mobility, including walking distance maintained or improved, strength improved

Table 1. (*Continued*)

Study	Intervention	Delivery	Treatment intensity	Treatment duration	Main findings
Schoenfelder (2000) USA (n = 16)	Ankle strengthening and walking exercises	Research staff	20 min × 3 per week	3months	Improved fall-related outcomes and mobility, reduced fear of falling
Schoenfelder (2004) USA (n=81)	Ankle strengthening and walking exercises	Research staff	15–20 min × 3 per week	3months	Balance improved, no benefits for mobility
Silhoven (2004) Finland (n = 28)	Visual feedback-based balance exercises	N/R	× 3 per week	4weeks	Balance improved
Stamford (1972) USA (n = 17)	Treadmill walking	N/R	9–20 min daily Mon–Fri	12weeks	No clear effects
Stevens (2006) Australia (n = 120)	Range of movement exercises, gentle aerobic exertion	Researchers	30 min × 3 per week	12weeks	Less functional deterioration, slower cognitive deterioration, possible benefits to mood and socialisation
Tappen (1994) USA (n=72)	Practice with daily living activities	Specialist nurse and rehabilitatio aide	2.5 h × 5 per week	20weeks	No clear effects, including function
Tappen (2000) USA (n=71)	Walking practice or 'walking and talking'	Intervener or interviewer	30 min × 3 per week	16weeks	Less functional decline for 'walk and talk' group, no benefits for mobility
Urbscheit (2001) USA (n = 13)	Balance and strengthening exercises with or without Swiss ball exercises	Physical therapy student	× 2 per week	8weeks	No clear intervention effect, including balance
Yoder (1989) USA (n=30)	Added purpose versus rote exercises	Researcher	N/A	N/A	Added purpose exercise condition elicited significantly more exercise repetitions

N/R, not reported; N/A, not applicable; ADL, activities of daily living.

tended to maintain or improve physical function) for older people (defined as aged ≥ 60years) who were permanent residents in long-term care were identified. Our primary outcome of interest was activity restriction. Additional outcomes such as strength and mood were also considered (Appendix B available at *Age and Ageing* online.). Studies directly addressing falls were excluded as they are already covered by a more specific review [7].

Clearly irrelevant titles were eliminated. Two independent reviewers further assessed titles and abstracts for eligibility, translated into English where appropriate. Full texts were obtained and three reviewers independently assessed each trial. Authors were contacted to clarify missing data. A standardised form was used to extract data and grade methodological quality (Appendix C available at *Age and Ageing* online.). Consensus was reached by discussion if disagreement arose.

Data analysis

The heterogeneity of these studies and differences in outcome measurements precluded meta-analysis. Therefore, this review provides a narrative synthesis whereby subjective rather than statistical methods are used to examine the direction and size of the effect, its consistency across studies and the strength of the evidence.

Results

The search strategy produced over 20,000 references from which 49 trials involving 3,611 subjects met the inclusion criteria (Figure 1) [8–56]. Study details are provided in Table 1.

Study characteristics

Thirty trials were conducted in the USA and 11 in Western Europe. A mean of 48% of home residents were eligible for study entry, and 62% of eligible participants were randomised (based on data from 18 and 19 trials, respectively). While proportions varied, over two-thirds of participants were female. Four trials were entirely female [9, 24–26] and two entirely male [22, 23]. People with cognitive impairment were excluded in 34 trials but specifically included in six [13–18]. Reported mean ages ranged from 69 [19] to 89 [20] years, with an estimated average of 82years.

A mean of 74 participants were randomised per study (range: 12 [22] to 468 [49]) and only nine trials included ≥100 participants [31–33, 41, 49–53]. All trials assessed participants after intervention completion but only 12 studies included longer term follow-up [11, 19, 25, 31, 32, 35, 48, 49, 52, 54–56]. No trials followed participants for longer than 1 year. In 25 trials, the intervention was compared to a 'usual care' control group; 16 used a social or recreational activity

control group and 12 studies compared two exercise regimes. Ten studies were cluster randomised trials.

Methodological quality

Twenty-seven trials reported no significant baseline differences between groups; 10 reported statistically significant between-group differences [11, 16, 18, 39–41, 47, 48, 52, 56]. Allocation concealment was rated as 'clearly adequate' in six trials [31, 32, 36, 50–52], 'clearly inadequate' in two [38, 44] and 'unclear' in the remaining 41. Outcome assessments were reported as fully concealed by 12 trials [14, 18, 32–37, 45, 48, 50, 56] and unconcealed in five [24, 26, 40, 46, 47].

Rates of post-randomisation attrition varied considerably, with an overall mean loss of 14%. Attrition >20% was reported in 13 trials [13, 15, 16, 20, 29–31, 33, 35, 42, 45, 48, 51]. Eleven trials reported 100% retention [8, 11, 23, 26–28, 34, 38, 44, 54, 56].

Intervention characteristics

Exercise, defined as an activity requiring physical effort intended improve or maintain fitness, was a component in all but three interventions [17, 24, 32]. Most interventions contained components targeted at reducing activity restriction, in particular walking and endurance [12, 14, 17–19, 23, 29–31, 34, 40, 42, 45, 46, 48–56], and general daily living skills [12, 13, 15, 17, 34, 42, 43, 45, 46, 50–53], e.g. eating, dressing and climbing stairs. Other components were muscle strengthening [9–11, 19, 20, 22, 30, 35, 36, 38, 39, 41, 43, 49–56], flexibility [9, 10, 15, 19, 21, 36, 44–47, 50], balance [9, 31, 35, 39, 45, 46, 50, 52, 56], social activities [12–14, 18, 31] and nutritional supplementation [41, 52].

Modal intervention duration was 12 weeks [9, 15, 19, 20, 22, 23, 32, 40, 54, 55] (mean: 18 weeks; range: 4 weeks [25] to 2 years [33]). The modal number of sessions per week was three (23 studies; mean: 3.5; range: 1 [8] to 20 [34]) with each session lasting ≤30 min in 18 trials [8, 9, 11, 14–16, 18, 23, 25, 29, 38, 39, 44, 46, 49, 50, 54, 55] but ≥1 h in seven [17, 19, 21, 22, 31, 36, 43]. In 27 studies, the intervention was delivered to a group of residents. Session attendance rates were frequently unreported but the mean attendance rate for 17 studies was 84% (range: 71 [43] to 97% [41]).

Effects on activity restriction

Thirty-five trials reported an outcome measure relating to activity restriction [8, 11–18, 21, 22, 30–41, 43, 45–55], most commonly walking. Improved mobility was reported in 24 trials [8, 12, 13, 15, 22, 30, 31, 36–43, 45, 46, 48–54] and did not improve in seven [9, 14, 18, 29, 34, 35, 55]. Mobility improvements included greater walking distance [12, 42, 43, 53], speed [12, 22, 30, 41–43, 51, 52], endurance [12, 30, 48, 49], improved gait [39], stair climbing [41], speed of chair rising [8, 36, 37, 39, 45, 46, 51] and reduced use of aids [48, 50]. Interventions improving mobility included those in which everyday actions (e.g. getting out of a chair) were practiced [13, 33, 42, 45, 51], strengthening and aerobic exercise [22], Tai Chi [40] and physical and occupational therapy [33].

Other activity restriction outcomes were reported in 20 studies [8, 11, 13, 14, 16–19, 21, 31–33, 43, 45–51], typically using standardised measures of daily living activities. There was functional improvement in nine studies [8, 11, 13, 31, 33, 43, 46–48], less deterioration in four [16, 18, 32, 49] and no clear effects in seven [14, 17, 19, 21, 45, 50, 51].

Effects on other outcomes

Measures of muscle strength were improved in 18 studies [10, 11, 13, 20, 22, 30, 36, 38, 40, 41, 43, 45–48, 51–53]. Eight trials assessed flexibility [13, 30, 37, 40, 44, 45, 47, 50] and all but one [50] reported improvements. Of the 16 trials that assessed balance as an outcome [9, 19, 22, 25, 35–37, 39, 40, 45, 46, 49, 50, 54–56], 12 reported improvements in balance, no change in one study [56] and a deterioration in two studies [49, 50]. Measures of mood, behaviour and cognitive performance were included in some studies and improvements in mood and socialisation [16, 21, 39], a reduction in agitation [34] and fear of falling [40, 54] were reported.

Larger studies

Of the nine trials recruiting over 100 subjects, all reported positive findings in relation to mobility [31, 41, 50, 52, 53], other daily living activities [32, 33, 49] or strength [51].

Adverse events

Only six trials included adverse event reporting [31, 37, 39, 41, 48, 50] with one or two patients per intervention group experiencing joint and musculoskeletal pain [37, 41, 48, 50], lower limb tingling [39] or high risk of falls [31].

Discussion

This systematic review provides a substantial body of research evidence with the inclusion of 49 randomised controlled clinical trials and >3,000 subjects. Although the individual trials predominantly have small sample sizes, a consistency of response can be observed with statistical benefits in relation to mobility and, less frequently, daily living activities. Caution is required in interpreting the findings of the review, as some selection bias is likely to have taken place as just over half of the eligible patients were recruited. However, even the healthiest long-term care residents could be described as dependent on the basis of their need for the specialist care setting. Although the trial entry criteria were not always well described, at least 17 studies recruited participants who could walk a few metres with or without an aid [9, 10, 14, 22, 23, 31, 35, 36, 38–43, 54–56]; five studies included residents who needed help to stand [15, 17, 25, 51, 52] or required assistance with daily living activities [21, 27, 28] or were sedentary [11] or required physical restraints [30]. Thus, the study populations comprised dependent older people. In this sense, the findings of the review are important as they may also be applicable to

dependent older people being supported at home. Here, the aim is to at least prevent deterioration and a programme of regular exercises, suitable for people with limited cardiovascular reserve, might be a simple and cost-effective therapeutic strategy to achieve this objective.

The clinical and lifestyle impacts for the individuals recruited to these predominantly short-term studies are difficult to judge but the effect sizes for mobility and activity restriction must be reasonably large to account for frequently positive outcomes from the typically small sample sizes of the included studies. Also, the interventions investigated appear quite plausible for deployment in routine care. They were predominantly simple static and/or dynamic movement exercises, some suitable for chair-fast residents and delivered at modest frequency, often in groups, >30 min two or three times each week. The estimate of 84% mean attendance rate (based on 17 studies) suggests reasonable acceptability to residents in long-term care. Although the interventions were largely delivered by healthcare professionals in the context of a research study, exercise programmes delivered by long-term care staff would be a reasonable alternative once an evidence-based exercise regime had been defined.

The review findings suggest that residents in long-term care should be dissuaded from adopting an overly sedentary lifestyle and reassured that a regular exercise programme is likely to promote mobility and daily living activities. A major limitation of this review is the paucity of information on longer term outcomes and the quantification of possible harms associated with exercise programmes in this potentially vulnerable group of older people. More research should be conducted to define generalisable exercise programmes, capable of delivery by care home staff and evaluated in sufficiently powered studies with a reasonable period of follow-up to provide more reliable estimates of benefits and harms.

Key points

- Provision of physical rehabilitation to older people resident in long-term care has been investigated in 49 randomised controlled trials.
- Most of the evidence related to exercise programmes delivered for 30 min two to three times per week.
- Exercise programmes are feasible and improvements in mobility and function are commonly observed.
- Longer term outcomes and associated harms have not been reliably identified.

Acknowledgements

This review is based on the full Cochrane review published in the Cochrane Database of Systematic Reviews on The Cochrane Library. We thank the Cochrane Stroke Group Editorial Team for its support during the development of this review, particularly Brenda Thomas and Hazel Fraser. We are pleased to acknowledge our colleagues, Jane Smith, John Green, Jo Hardy and Eileen Burns, who assisted with the Cochrane Review. We thank Pat Spoor, Ros Dunlevey and Rosemary Campbell-Blair (University of Leeds, Health Sciences Library) who undertook the literature searches.

Conflict of interest

None.

Funding

We are grateful to The Physiotherapy Research Foundation UK for providing the funding for this review. They did not play any part in its completion or this paper.

Supplementary data

Supplementary data are available at *Age and Ageing* online.

References

(The long list of references supporting this review has meant that only the most important are listed here and are represented by bold text throughout the review. The full list of references is available at *Age and Ageing* online.)

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Received 24 July 2009; accepted in revised form 29 October 2009