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Orthogeriatrics

The Management of Older Patients with Fragility Fractures

Second Edition

In Collaboration with
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12.1 The Need for Increased Provision of Rehabilitation Worldwide

The World Health Organization has recently highlighted a substantial unmet need for rehabilitation worldwide, with a 2017 Call-to-Action to increase the role of rehabilitation in health care as an essential component of integrated health services [1]. It was acknowledged that there is a profound unmet need for rehabilitation,

This chapter is a component of Part 3: Pillar II.
For an explanation of the grouping of chapters in this book, please see Chapter 1: "The multidisciplinary approach to fragility fractures around the world—an overview".

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particularly in LMICs. There was a call for greater access to rehabilitation services recognising it as an essential part of the health system rather than an optional extra. Rehabilitation is "an investment in human capital that contributes to health, economic and social development" and there is under-prioritisation by governments with an absence of planning for services at a national and subnational level. The call to action includes "greater awareness and advocacy, increased investment into rehabilitation workforce and infrastructure, and improved leadership and governance structures". This includes increasing networks and partnerships in rehabilitation, particularly between LMICs and high-income countries.

12.2 The Principles of Rehabilitation Programmes after Hip Fracture

After a hip fracture operation, an older person's recovery is enhanced if they are provided with an optimistic, well-coordinated rehabilitation programme. Recovery after hip fracture starts on admission when the patient and family receive realistic information on the likely course and time of discharge. The earlier patient goals and expectations can be explored and information on barriers or supports for recovery of independence identified, the more likely it is that an individual will retain a sense of control and self-efficacy which is likely to be associated with better outcomes [2, 3]. Consistent information on the planned rehabilitation programme is important as most people will have a recovery pathway which extends for several months across hospital and community settings [4].

During the acute hospital stay (ideally on an orthogeriatrics ward), along with secondary prevention treatments for osteoporosis, a rehabilitation pathway should be established and outlined to the patient and family. Rehabilitation involves diagnosing and treating impairments, preventing and treating complications, slowing loss of function and where this is not possible, compensating for lost functions (e.g. prescribing walking aids, bathroom adaptations, additional home help) [5]. Several systematic reviews and meta-analyses have demonstrated that rehabilitation programmes improve outcomes for patients after hip fracture compared to simply letting time take its course [6–8]. However, the components of recovery/rehabilitation programmes vary, including the length of time and the settings where programmes are delivered (home, inpatient units, outpatients). Standard management of hip fracture patients also varies between different countries. An audit in the UK reported that 70% of hip fracture patients receive orthogeriatrician assessment and 92% a falls assessment. These figures were only 27% for orthogeriatrician assessment and 4% for falls assessment in a tertiary hospital in Beijing [9].

In clinical practice, the cornerstone of a rehabilitation approach is a team of various disciplines (physiotherapy, occupational therapy, nutrition, social work, psychology, medicine) who meet regularly, set goals, review progress towards these goals with the patient and assess outcomes. The chance of recovery is maximised if the following elements are incorporated into the clinical approach:

- *Assessment*: identification of problems to be addressed, which involves understanding the premorbid level of functioning and understanding the current comorbidities (e.g. delirium).

- *Goal-setting*: identifying what can be improved and what cannot. In particular, assessing what level of mobility and independence in bathing and dressing is likely to be achieved in the short, medium and long term. Similarly, identifying what informal and formal supports are available to help recovery.
- *Treatment*: intervening to improve medical and functional problems (such as pain, vitamin D deficiency, undernutrition, depression) as well as physical and psychosocial interventions to meet the rehabilitation goals.
- *Evaluation*: reviewing the effectiveness of interventions (i.e. reassessment).
- *Planning*: organising support services; providing self-management strategies for patients and carers.

The World Health Organization (WHO) International Classification of Functioning, Disability and Health (ICF) framework provides a standardised framework for the classification and description of health, functioning and disability [10]. It moves away from the idea that disability is simply the consequence of disease or ageing towards an approach that acknowledges factors created by the social environment and it attempts to explicitly identify barriers and facilitators to social inclusion. Functioning and disability are seen as multidimensional concepts, relating to:

- Body functions (physiological and psychological functions of body systems) and structures (anatomical parts of the body such as organs, limbs and their components);
- Activities people do and the life areas in which they participate;
- Factors in people's environment (physical, social and attitudinal) which can be barriers or facilitators to functioning.

If this approach is applied to a person who suffers a hip fracture, their disability will be assessed and ranked according to the ICF framework components of health domains (e.g. seeing, hearing, walking, memory) and health-related domains (e.g. their ability to access transport, their level of education and social interactions). Figure 12.1 shows an individual's functioning or disability as a dynamic interaction between health conditions and contextual factors, which encompass both environmental and personal factors [10].

12.3 What Is Known about the Pattern of Recovery Following Hip Fracture?

Talking to people with hip fractures and their families and providing realistic information on approximate expected recovery trajectories allows them to plan. However, it is complex for clinicians to apply evidence from cohort studies to individual patients as the cohorts are heterogeneous and patients have received varying amounts and types of rehabilitation.

Cohort studies suggest that following hip fracture, only 40–60% of people who survive are likely to recover their pre-fracture level of mobility [11]. Up to 70% may recover their level of independence for basic activities of daily living, but this is variable and less than half of all people experiencing hip fracture may regain their ability to perform instrumental ADLs. In Western nations, approximately 10–20% of patients move to a residential care facility following hip fracture. The extent to which these outcomes can be improved with greater access to rehabilitation is not clear.

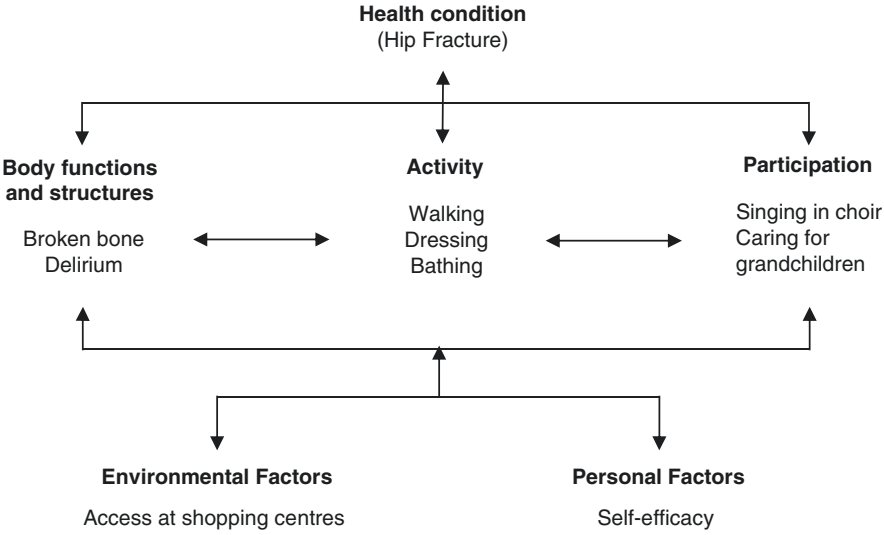

Fig. 12.1 Interactions between the components of the World Health Organization (WHO) International Classification of Functioning, Disability and Health (ICF) framework. *Source*: WHO 2001 [10]

Magaziner et al. described the sequence of recovery across eight different functional abilities following hip fracture [12]. Upper extremity activities of daily living, depression and cognitive function reached maximum recovery within 4 months. Most recovery of gait and balance occurred in the first 6 months, with maximum recovery occurring by 9 months; recovery of instrumental ADLs (such as shopping, preparing meals, house cleaning and handling money) took up to a year. It also took approximately a year for recovery of lower limb function and just over 14 months for walking 3 m without assistance. It seems that the majority of patients who recover their pre-fracture walking and basic activities of daily living do so within the first 6 months after fracture [13], but the role of long-term therapy in recovery pathways is yet to be well investigated.

In LMICs outcomes may be poorer due to reduced rates of optimal management, particularly due to reduced access to rehabilitation services [1]. In many LMICs standard hip fracture management pathways are not established [14]. Barriers to providing rehabilitation services in LMICs are discussed in more detail in Tables 12.10 and 12.11. An audit of practice in China (considered an upper MIC) demonstrated reduced access to surgery and orthogeriatric services at a Beijing hospital in comparison to the United Kingdom [9]. Since that time a retrospective before–after study has demonstrated that improvements in both time to surgery and orthogeriatric management are possible with implementation of a co-management care plan [15].

12.4 Factors Associated with Poor Outcomes After Hip Fracture

Some types of patients with hip fracture appear to be at particular risk of poor outcomes – these include male patients, people living in supported accommodation, those with poorer mobility pre-fracture and those with depression or dementia [13, 16, 17]. People with dementia are also less likely to receive rehabilitation [17, 18]. For people with dementia who receive rehabilitation, improvements comparable to other populations are achievable but this may take longer [19]. Although mortality following hip fracture has been found to be higher in men than women, recovery of mobility is unaffected by gender [17, 20].

Delirium is very common after hip fracture and although it is associated with poorer outcomes, routine assessment by rehabilitation staff remains uncommon [13]. In one prospective study, delirium remained in 39% of people with hip fracture at discharge from hospital and in 32% 1 month after fracture [21]. Even after controlling for pre-fracture physical and cognitive frailty those people who had delirium were twice as likely to have poor functional outcomes (in terms of mobility and recovery of activities of daily living) than those without [21].

Those who are older are more likely to have poorer mobility, need assistance at home, lose their ability to go outside on their own, cook their own dinner and be unable to prepare their own breakfast [17, 20]. Low food intake post-operatively, poor nutrition and malnourishment pre-operatively are associated with worse recovery of mobility and function [22, 23]. A systematic review of nutritional interventions found low-quality evidence to support the effectiveness of multi-nutrient supplements started before or soon after surgery in older people recovering from hip fracture to prevent complications [24]. Amongst nursing home residents, the factors most strongly associated with death or new total mobility dependence are being aged more than 90, having very severe cognitive impairment and receiving non-operative management of the hip fracture [25]. Longer lengths of stay, re-hospitalisation, older age, chronic or acute cognitive deficits and depressive symptoms while in hospital are also predictive of poorer recovery of mobility and activities of daily living [13].

12.5 Key Elements of a Rehabilitation Pathway

After the immediate post-operative period, a rehabilitation pathway should be followed that includes the elements addressed in Table 12.1. In particular, there is a need to assess frailty, establish goals to maximise mobility and other aspects of function, assess the requirement of aids (using occupational therapy services where available) and determine strategies to support and improve independence in activities of daily living [26]. Medication management should ensure all prescribed medications are necessary, minimise the use of antipsychotics and sedatives and ensure adequate pain management. Osteoporosis should be treated as appropriate and falls prevention strategies reinforced with both patients and families.

Table 12.1 Key elements of a typical rehabilitation pathway, based on the Alberta Hip Fracture Restorative Care Pathway [26]

Category of care	
Frailty	Undertake frailty assessment, instigate interventions as appropriate, involve patient in establishing goals to maximise function and achieve safe discharge
Activities of daily living	Ensure progression in recovery of pre-fracture level of independence, aiming for further improvement depending on tolerance Assess need for aids and develop strategies to improve independence Demonstrate safe transfer using aids and equipment as appropriate Ensure there is adequate support in the home environment in terms of assistance from a caregiver or service Recommend the family consider a medical alert system if available and appropriate *Bathing and grooming*: Encourage and support independence, bathing and grooming out of bed with assistance if necessary *Dressing*: Support getting out of bed and dressed daily, using dressing aids as necessary *Toileting*: Encourage regular toileting to promote continence, toileting should be in the bathroom, not using bedpans or urinals *Eating*: A high protein/calorie diet should be continued and meals taken in a chair or dining room. An oral nutritional supplement should be considered Support for activities of daily living should be provided after discharge. Appropriate home equipment should be provided (mobility aid, raised toilet seat and toilet surround and other items as required)
Mobility	Consider conducting an assessment of mobility/activities of daily living to enable monitoring of recovery of mobility (e.g. the Timed Up and Go test, Barthel Index of Activities of Daily Living) Exercise incorporating strengthening, balance and functional components should be continued after discharge
	Walking with or without an aid for at least 50–100 m should be undertaken at least three times daily, or as appropriate depending on pre-fracture mobility Capacity to walk the distance required to attend meals in the home setting should be demonstrated Ensure ability to manage stairs if necessary and to mobilise safely outside the home in all weather conditions, uneven surfaces, curbs, etc. Arrange further mobility training after hospital discharge
Medications	A review of all medications should have been undertaken on admission, polypharmacy should be addressed Use of sedatives and antipsychotics should be minimised or ceased and doses should be regularly reviewed Medication should be adequate for pain control to enable optimal independence in activities of daily living
Cognitive and mental status	Strategies to prevent and treat delirium should be continued, including ensuring appropriate use of vision and hearing aids, fluid enhancement, orientation, optimising mobility and non-pharmacological sleep supporting strategies. Behaviour monitoring should be undertaken if necessary Activity should be encouraged for those with dementia or depression, in terms of ambulation, exercise and social participation Caregivers should be provided with support and access to community resources as appropriate
Prevention of further falls/ fractures	Osteoporosis management should be considered if this hasn't already occurred and continued post-discharge Fall prevention strategies should be instigated and the use of hip protectors (if available) considered

12.6 What Programmes Should We Recommend to Help with Recovery?

It is widely recognised that a vicious cycle can occur after a hip fracture where pain and hospitalisation result in disuse atrophy of muscles and general deconditioning which increases the risk of immobility and new falls and fractures [27]. While national clinical guidelines recommend providing balance and strengthening exercise [28, 29], it is often unclear how much should be provided, what components of a rehabilitation programme are crucial and how long this programme should be provided for. Analysis of the components of interventions found to be effective in randomised trials can assist in addressing this uncertainty.

The characteristics of all randomised controlled trials of multidisciplinary rehabilitation approaches reporting impact on patient-centred outcomes or mortality (Table 12.2) and exercise and mobility training programmes (Table 12.3), within different settings as identified by systematic review to 2019, are presented below [30, 31]. The quality of the trials is represented with the Physiotherapy Evidence Database (PEDro) score (see https://www.pedro.org.au/), which scores ten items reflecting trial design including randomisation, blinding, balance in baseline characteristics and follow-up. Details of the components of the programmes that have been demonstrated to be effective at improving mobility or function in randomised controlled trials are shown in Table 12.4 (multidisciplinary interventions in hospital or hospital and community setting), Table 12.5 (exercise programmes conducted in hospital settings), Table 12.6 (community-based multidisciplinary interventions) and Table 12.7 (community-based exercise programmes).

12.6.1 In-hospital Rehabilitation

Multidisciplinary programmes have been researched over a long period of time with significant changes to the components of treatment programs. Some trials provide a comparison to a usual care control group while others have a standard rehabilitation programme as the control group. Furthermore, some multidisciplinary programs begin soon after admission (e.g. Prestmo et al. [40]) and others include both in hospital rehabilitation and community components (e.g. Cameron et al. [45]). A 1988 trial demonstrated improvements in function on discharge for provision of multidisciplinary care in comparison to standard orthopaedic care [37].

Table 12.4 shows the characteristics of hospital-based and hospital-plus community-based multidisciplinary rehabilitation interventions in studies with demonstrated effectiveness. Four trials of programmes delivered solely in a hospital setting have demonstrated effectiveness on patient-centred outcomes overall (Table 12.4). One effective in-hospital programme with comprehensive, multidisciplinary geriatric care including early mobilisation, and daily training and a follow-up assessment at 4 months, demonstrated improvements in function at 1 year [42]. Another trial demonstrated improvements in mobility with orthogeriatric care for a subgroup who were living at home [44]. A third trial demonstrated reduced rates of delirium with daily geriatrician visits [38].

Table 12.2 Characteristics of trials of multidisciplinary rehabilitation approaches reporting impact on patient-centred outcomes or mortality

Study	Setting	Sample size	PEDro	Patient-centred outcomes	Characteristics of intervention	Comparator
Hospital-based programmes						
Baroni 2019 [32]	H	430	6[a]	Mortality	Geriatric consultation service	Orthogeriatric comanagement
Chong 2013 [33]	H	162	5[a]	Function, mobility, institutionalisation, mortality, quality of life	Integrated care pathway: Usual care plus structured therapy assessments and checklists	Usual care within multi D team
Fordham 1986 [34]	H	108	5[a]	Poor outcome at discharge,[b] mortality, function, mobility	Joint geriatric and orthopaedic management	Orthopaedic management
Galvard 1995 [35]	H	378	4	Poor outcome at discharge,[b] mortality	Geriatric rehab within geriatric hospital	Usual orthopaedic care
Gilchrist 1988 [36]	H	222	5	Poor outcome at discharge,[b] mortality	Combined geriatric–orthopaedic care in special designated unit	Usual orthopaedic care in orthopaedic ward
Kennie 1988 [37]	H	108	6	Poor outcome at discharge and poor outcome at long-term follow-up,[c] mortality, function	Multi D care in orthopaedic beds at peripheral hospital, plus allied health visits	Usual orthopaedic care in orthopaedic ward, plus allied health
Marcantonio 2001 [38]	H	126	8[a]	Delirium	Proactive geriatrics consultation	Usual care
Naglie 2002 [39]	H	280	7	Poor outcome at long-term follow-up,[d] mortality, function, mobility	Multi D care: Routine post-operative surgical care, daily geriatrician care, allied health, emphasis on prevention, mobilisation, self-care, discharge planning	Usual care on orthopaedic unit
Prestmo 2015 [40]	H	397	6	Mobility, quality of life, function	Comprehensive geriatric care	Usual orthopaedic care
Sanchez Ferrin 1999 [41]	H	206	6[a]	Function, mobility, mortality, institutionalisation	Evaluated by the functional geriatric unit	Usual care

Table 12.2 (continued)

Study	Setting	Sample size	PEDro	Patient-centred outcomes	Characteristics of intervention	Comparator
Stenvall 2007 [42]	H	199	6	Poor outcome at discharge and long-term follow-up,[e] mortality, function, mobility, independent living	Comprehensive geriatric care with assessment at 4-months	Usual care on specialist orthopaedic ward No 4-month assessment
Uy 2008 [43]	H	10	6	Function, mobility	Inpatient multi D rehab programme, using system of accelerated rehab	Usual care (discharge back to NH soon after surgery)
Watne 2014 [44]	H	329	7[a]	Delirium, mortality, mobility	Patients treated in acute geriatric ward: Comprehensive geriatric assessment, daily multi D meetings	Usual care in orthopaedic ward
Hospital- and community-based programmes						
Cameron 1993 [45]	H&C	252	6	Poor outcome at discharge and long-term follow-up,[f] mortality, function	Accelerated rehab and early discharge	Usual care
Crotty 2003 [46]	H&C	66	6	Poor outcome at long-term follow-up,[c] mortality, quality of life, function, mobility	Ambulatory geriatric interdisciplinary rehab programme	Usual care
Huusko 2002 [47]	H&C	260	5	Poor outcome at long-term follow-up,[f] mortality, function	Intensive geriatric rehab in hospital, multi D geriatric team, physio sessions and ongoing treatment at home post-discharge	Discharge to local community hospitals, treatment by GPs, physiotherapists
Jette 1987 [48]	H&C	68	2	Function (ADLs and social function)	Intensive rehab programme: Standard programme plus individualised patient and family education, comprehensive assessment, weekly team meetings, home visit and telephone calls post-discharge	Standard post-surgical rehab programme, including follow-up visits to clinic at 6 weeks, 3, 6, and 12 months post-discharge

(continued)

Table 12.2 (continued)

Study	Setting	Sample size	PEDro	Patient-centred outcomes	Characteristics of intervention	Comparator
Karlson 2016 [49]	H&C	205	8	Mobility, function, delirium, quality of life	Usual care and geriatric multi D home rehab, with aim of early discharge, individually designed, conducted by multi D team, for 10 weeks	Usual care and rehab in geriatric ward with comprehensive geriatric assessment, post-discharge primary HC and outpatient rehab at 3 months as needed
Shyu 2010 [50]	H&C	162	7	Poor outcome at follow-up,[g] function, mortality, mobility, quality of life	Interdisciplinary programme	Usual care on trauma or orthopaedic ward. No follow-up care post-discharge
Shyu 2013 [51]	H&C	299	6[a]	Function	1. Interdisciplinary care 2. Comprehensive care	Usual care: Current routine care of hip fractured elders in Taiwan, no continuation of rehab in home setting
Singh 2012 [52]	H&C	124	5	Function, mortality, residence, mobility, quality of life	Geriatrician supervised, high-intensity resistance exercise and targeted multi D interventions	Standard care: Orthogeriatric care, rehab service and physio
Swanson 1998 [53]	H&C	71	6	Poor outcome at discharge, mortality, mobility, function	Accelerated rehab programme involving multi D team	Standard orthopaedic management. Home visits as needed post-discharge
Vidan 2005 [54]	H&C	321	6	Poor outcome at long-term follow-up,[c] mortality, function, mobility	Multi D care—Geriatric team, assessments, rehab specialist, social worker, comprehensive treatment plan	Usual orthopaedic care. Specialist counselling as required
Ziden 2008 [55]	H&C	102	6	Function, mobility, quality of life	Home Rehab (HR) programme	Conventional Care (CC) and rehab, discharged home or to short-term NH
Community-based programmes						
Crotty 2019 [56]	C	240	7[a]	Mobility, quality of life, function, delirium	Multi D post-op rehab programme within NH	Usual care within NH

Table 12.2 (continued)

Study	Setting	Sample size	PEDro	Patient-centred outcomes	Characteristics of intervention	Comparator
Ryan 2006 [57]	C	71	6	Poor outcome at long-term follow-up,[c] mortality, function	Intensive treatment: ≥6 face-to-face contacts pw from members of a multi D rehab team	Less intensive treatment: ≤3 face-to-face contacts pw with members of multi D rehab team

Note: as identified by systematic review to October 2019. [a]Scored in duplicate by authors
ADLs activities of daily living, *C* community only, *GP* general practitioner, *H* hospital only, *H&C* hospital and community, *HC* health care, *IADLs* instrumental ADLs, *multi D* multidisciplinary, *NA* not available, *NH* nursing home, *physio* physiotherapist/physiotherapy, *post-op* post-operative, *pw* per week, *rehab* rehabilitation
NB Poor outcome = reviewer calculated composite outcome, defined as: [b]mortality at discharge or discharge to more dependent residence/NH, [c]mortality at 12 months or living in more dependent residence/NH, [d]mortality at discharge, discharge to more dependent residence and decline in mobility, [e]mortality at discharge, not discharged to previous residence, not in same residence at 12 months and reduced ADLs, [f]mortality at discharge or discharge to institutional care, mortality at 12 months or institutional care, [g]12-month mortality, admission to institutional care or decline in function

Table 12.3 Characteristics of trials of exercise and mobility training programmes reporting impact on mobility or function outcomes[a]

Study	Setting	Sample size	PEDro	Main mobility outcome	Characteristics of intervention	Comparator
Hospital-based programmes						
Kimmel 2016 [58]	H	92	7	Modified Iowa Level of Assistance (mILOA)	High-intensity functional training	Usual care
Kronborg 2017 [59]	H	90	7	Timed Up and Go	Progressive resistance	Usual care
Mitchell 2001 [30]	H	80	5	Elderly Mobility Scale	High-intensity progressive resistance	Usual care
Monticone 2018 [31]	H	52	7	Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)	Balance exercises	Usual care/ open kinetic chain exercises in the supine position
Moseley 2009 [60]	H	160	8	PPME	High-intensity weight-bearing	Usual care
Ohoka 2015 [61]	H	27	4	Gait speed	Body weight-supported treadmill training	Usual care
Resnick 2007 [62]	H	208	6	Self-efficacy WES	Exercise plus or exercise only[b]	Usual care
Sherrington 2003 [63]	H	80	7	PPME	Weight-bearing	Non weight-bearing
Van Ooijen 2016 [64]	H	70	5	Elderly Mobility Scale	Treadmill vs. adapted treadmill	Usual care

(continued)

Table 12.3 (continued)

Study	Setting	Sample size	PEDro	Main mobility outcome	Characteristics of intervention	Comparator
Community-based programmes						
Binder 2004 [65]	H&C	90	7	Modified PPT	High-intensity progressive resistance	Low-intensity non-progressive
Hauer 2002 [66]	H&C	28	6	Tinetti's POMA	High-intensity progressive resistance	Placebo motor activity
Langford 2015 [67]	C	30	7	Gait speed	Additional post-discharge physiotherapist telephone support and coaching	Usual care
Latham 2014 [68]	H&C	232	6	SPPB	Home-based exercise	Attention control
Magaziner 2019 [69]	C	210	8[c]	6 min walk distance	Aerobic, strength, balance and functional training	TENS and range-of-motion exercises
Mangione 2005 [70]	C	41	5	6 min walk distance	Resistance or aerobic exercise	Education
Mangione 2010 [71]	C	26	7	6 min walk distance	Home-based resistance	Attention control
Orwig 2011 [72]	C	180	6	Study primary outcome: bone mineral density; mobility: 6 min walk test	Progressive resistance and aerobic	Usual care
Salpakoski 2014 [73]	C	81	8	Short physical performance battery	Progressive resistance, balance and functional	Usual care
Sherrington 1997 [74]	C	42	5	Gait velocity	Weight-bearing	Usual care
Sherrington 2004 [75]	C	120	7	6 m walk time	Weight-bearing or non-weight-bearing	No intervention
Stasi 2019 [76]	C	96	7	Timed Up and Go	Progressive resistance	Usual care
Sylliaas 2011 [77]	C	150	8	6 min walk distance	Progressive resistance	No intervention
Sylliaas 2012 [78]	C	95	8	6 min walk distance	Prolonged resistance	No intervention
Tsauo 2005 [79]	C	54	4	Walking speed	Home-based physiotherapy	Bedside exercise
Williams 2016 [80]	C	61	8	Timed Up and Go	Additional physiotherapy	Usual care

C community only, *H* hospital only, *H&C* hospital and community, *N* no, *PPT* Physical Performance Test, *POMA* Performance Oriented Mobility Assessment, *PPME* Physical Performance Mobility Examination *SPPB* Short Physical Performance Battery, *TENS* transcutaneous electrical nerve stimulation, *WES* Walking Exercise Scale *Y* yes

[a]Based on systematic-review of MEDLINE, EMBASE, CINAHL, CENTRAL and PEDro database search records from inception to April 2019 for randomised controlled trials of exercise-based programmes aiming to improve mobility in older people post-hip fracture reporting data suitable for inclusion in meta-analysis, with a minim PEDro score of 5 or more

[b]Only two out of three comparison groups examined exercise interventions

[c]Scored in duplicate by current authors

Table 12.4 Trials of hospital- and hospital-plus community-based multidisciplinary rehabilitation interventions with demonstrated effectiveness

Study	Participants	Intervention type	Setting	Follow-up times	Outcome effect (95% CI)	Programme length	Control group
Multi D: Hospital only programmes							
Marcantonio 2001 [38]	People aged >65 years	Proactive geriatrics consultation: Daily geriatrician visits, consultation with targeted recommendations based on structured protocol	Acute hospital, USA	During hospital stay	Delirium: RR 0.64 (0.37–0.98) Severe delirium: RR 0.40 (0.18–0.89)	Hospital stay (median LoS 5 days)	Usual care—Management by orthopaedics team, geriatrics consults as needed
Prestmo 2015 [40]	People aged >70 years	Comprehensive geriatric care, structured and systematic interdisciplinary geriatric assessment, focus on physical and mental health, function and social situation, with early discharge planning and early mobilisation and rehab	Central hospital, Norway	1, 4 and 12 months post-surgery	Mean diff (12 months): Mobility (SPPB): 0.69 (0.10–1.28, $p = 0.023$) Function (ADL, Barthel): 1.13 (0.31–1.96, $p = 0.007$) Function IADL: 6.39 (2.59–10.19, $p = 0.001$) QoL (EuroQOL-5D-3L): 0.09 (0.02–0.16, $p = 0.015$)	Hospital stay (mean LoS 12.6 days)	Hospital stay, usual care on orthopaedic ward (mean LoS 11 days)
Stenvall 2007 [42]	People aged ≥70 years 64/N with dementia	Geriatric unit specialising in geriatric orthopaedic care, multi D team providing assessments and rehab, focus on prevention of post-op complications, and early mobilisation, with daily training. Assessment at 4 months for further rehab needs	Teaching hospital, Sweden	On discharge, at 4 and 12 months	Function (12 months): RR 0.65 (0.48, 0.88)	Hospital stay (mean LoS 30 days)	Usual care during hospital stay (mean LoS 40 days)
Watne 2014 [44]	People acutely admitted with hip fracture Subgroup analysis: Participants living in own home at baseline	Acute geriatric ward, key element being use of comprehensive geriatric assessment for treatment planning, plus daily multi D meetings	University hospital, Norway	4 and 12 months	Community-dwelling sub-group[a] (4 months) Mobility (median): CGA 6 vs. con 4 (95% CI for diff 0 to 2; $p = 0.04$)	Hospital stay (median LoS 11 days)	Usual care on orthopaedic ward (median LoS 8 days)

(continued)

Table 12.4 (continued)

Study	Participants	Intervention type	Setting	Follow-up times	Outcome effect (95% CI)	Programme length	Control group
Multi D: Hospital and community programmes							
Kennie 1988 [37]	Women aged ≥65 years, surgical repair 51/108 with at least MCI, 35 moderate to severe	Multi D care (GP, geriatrician, orthopaedic specialist) in orthopaedic beds at peripheral hospital. Transferred to rehab ward 0–7 days after trial entry. Patients also received physio, occupational therapy and other services	District hospital, discharged to community, UK	At discharge and 12 months	Poor outcome (12 months): RR 0.48 (0.31, 0.77) Function (more dependent): RR 0.64 (0.46, 0.89)	During hospital stay (mean LoS 37 days), then allied health allied health visits post-discharge similar to usual care	Usual orthopaedic care in orthopaedic ward (a few moved to other short stay wards) (mean LoS 56 days) Patients also received physio, OT and other services
Shyu 2010 [81]	People aged ≥60 years, not severely cognitively impaired One-third with mild cognitive impairment	Interdisciplinary programme—Geriatric consultation, continuous rehab and discharge planning. Early mobilisation, home visits by allied health professionals post-discharge	Teaching hospital, discharged to home, Taiwan	1, 3, 6, 12, 18 and 24 months	Poor function[b] (1 year): RR 0.59 (0.37, 0.95) Mobility (recovery at 2 years): OR 2.72 (11.53–4.84) Function (regression co-eff): $\beta = 9.22$, $p < 0.001$) QoL physical: $\beta = 6.08$, $p < 0.001$	Hospital stay (mean LoS 10.1 days) Usual care + 1 PT session/day (total 4 × ~20 min), 2 × PT assessments, 1 visit rehab physician Post-discharge: one time week 30 min home visits in first month 2 per month in second and third month	Usual care on trauma/orthopaedic ward in Taiwan (mean LoS 9.7 days) Exercises (nurses) in first 2–3 days Sessions varied: 3 sessions ($N = 18$), or 1 session (remainder) Discharge ~7 days from surgery No post-discharge care

Shyu 2013 [51]	People aged ≥60 years, admitted to hospital for fracture from home setting	Comprehensive care model: In addition to interdisciplinary care (geriatric consultation, comprehensive assessment, rehab programme, discharge planning, post-hospital services), also included nutrition consultation, depression management, fall prevention	Hospital and in patients' home, Taiwan	At discharge 1, 3, 6 and 12 months	Function (self-care, 0–12 months): OR 3.19 (1.47–6.89)	Rehab started on first day after surgery, and continued for 1 year in patients' home Mean LoS 8.34 days	Usual care in Taiwan. Average of 1.89 physical therapy sessions in hospital, no continuation of rehab in home setting Mean LoS 8.47 days
Singh 2012 [52]	People aged >55 years with sufficient cognitive ability	HIPFIT intervention: Geriatrician-supervised high-intensity weight-lifting exercise and targeted treatment of balance, osteoporosis, nutrition, vitamin D/calcium, depression, cognition, vision, home safety, polypharmacy, hip protectors, self-efficacy and social support	Public teaching hospital and surrounding geriatric and rehab hospitals, Australia	4 and 12 months	Mobility (assistive devices) relative effect size: –0.45 (–0.86, –0.04) Admission to institution (age-adjusted): OR 0.16 (0.04–0.64) Mortality (age-adjusted): OR 0.19 (0.04–0.91)	In addition to usual care, 80 supervised Exercise training sessions, 10 home visits, and 10 phone calls over 12 months	Standard care in area health service, including orthogeriatric care, rehabilitation service, allied health as required, and physio
Swanson 1998 [53]	People aged ≥55 years, independent and mobile None with dementia	Accelerated rehab programme: Multi D team (orthopaedic surgeon, geriatrician, nurse-coordinator, physio, other allied health). Early surgery, less analgesia, early mobilisation, intense physio, weekly case conference, home assessment before discharge, community services referrals. Follow-up 1 and 6 months post-discharge	Teaching hospital, discharged to home, Australia	At discharge and 6 months	Poor outcome (at discharge): RR 0.50 (0.16, 1.55)	During length of hospital stay (mean LoS 20.8 days), plus 6 months post-discharge	Standard orthopaedic management, daily physio visits, weekly discharge planning during stay. Mean LoS 32.6 days Home visits as needed post-discharge

(continued)

Table 12.4 (continued)

Study	Participants	Intervention type	Setting	Follow-up times	Outcome effect (95% CI)	Programme length	Control group
Ziden 2008 [55]	People aged ≥65 years	Home rehabilitation programme, on admission and after discharge: Early goal-setting, close cooperation with relatives, social home services, focus on early discharge, individual design, physio home visits (focus on self-efficacy and walking outdoors)	University hospital, Sweden	At discharge, at 1, 6, and 12 months	1-year median (range) Function (ADLs and IDLs: Home rehab 85 (46–91) vs. Con 80 (29–91); $P < 0.001$ Function (IADLs): Home rehab 27.0 (0–40) vs. Con 20.0 (0–42); $P = 0.028$	Median home visits 4.5 over 3 weeks post-discharge	Conventional care and rehab, discharged home with no continuing organised rehab or to short-term NH. Participation in standard rehab programme with physio and OT

ADLs activities of daily living, *CI* confidence Interval, *diff* difference, *GP* general practitioner, *IADLs* instrumental ADLs, *LoS* length of stay, *MCI* mild cognitive impairment, *multi D* Multidisciplinary, *NH* nursing home, *OR* odds ratio, *physio* physiotherapist, *OT* occupational therapy, *PT* physical therapy, *rehab* rehabilitation, *QoL* quality of life, *RR* risk ratio, *SPPB* short physical performance battery

[a]Trial effectiveness overall not significant

[b]Non-recovery of function/decline in walking

Table 12.5 Trials of hospital-based exercise and mobility training programmes with demonstrated effectiveness on mobility or function[a]

Study	Participants	Intervention type	Setting Adherence	Outcome effect size SMD (95% CI)	Programme dose	Control group	Control programme dose
Exercise: Hospital only programmes							
Mitchell 2001[b] [30]	People ≥65, mobile ± aid pre-fracture, AMT score ≥ 6	Early post-op, high-intensity bilateral quadriceps muscle strengthening (6 × 12 reps knee extension) progressive from 50% (weeks 1 and 2), 70% (weeks 3 and 4) to 80% (weeks 5 and 6), plus conventional physiotherapy	Rehabilitation unit, supervised, UK Median no. sessions completed (11, range 10–12)	Function: 1.33 (0.67, 1.99)	6 weeks, 2 × pw 30 min[c] Total: 6 h	Conventional physiotherapy	U weeks, 5 × pw, 20 min Total: U
Monticone 2018 [31]	People aged >70 years, MMSE >23, no major recent medical events	Balance task-specific exercises in standing (open and closed eyes, proprioceptive and balance-challenging tasks), 90-min sessions, five times per week for 3 weeks. Walking on a rectilinear trajectory while changing speed and direction, or while performing, additional exercises: Gait training (changes in speed and direction, motor-cognitive tasks), sit to stand, stairs and climbing obstacles	Rehabilitation unit, individual sessions supervised by physiatrist/ physiotherapist, Italy	Mobility: 1.91 (1.25, 2.58) Function: 1.31 (0.71, 1.92)	3 weeks, 5 × pw, 90 min Total: 22.5 h	General physiotherapy, including open kinetic chain exercises and walking training. Individual sessions supervised by physiatrist/ physiotherapist	3 weeks, 5 × pw, 90 min Total: 22.5 h

Diff difference, *MMSE* Mini-Mental State Examination, *pw* per week, *SMD* standardised mean difference, *wks* weeks, *U* unclear

[a]Based on analysis at end of intervention period

[b]Weeks, calculated as 1 month = 4 weeks (thus 6 months = 24 weeks)

[c]Estimated

Table 12.6 Characteristics of community-based multidisciplinary rehabilitation interventions in trials with demonstrated effectiveness

Study	Participants	Intervention type	Setting	Follow-up times	Effect: mean difference (95%CI)	Programme length	Control group
Crotty 2019 [56]	People aged ≥70 years, living in long-term care prior to injury, ready for discharge	Ambulatory geriatric interdisciplinary rehabilitation programme. Patients received visits from a hospital outreach team who provided a comprehensive geriatrics assessment, physio (mobility and task specific training), training of care staff and family	Recruitment in hospital, delivered in long-term care, Australia	4 weeks and 12 months	Mobility (NHLSD, 4 weeks): −1.9 (−3.3 to −0.57) QoL DEMQOL (1 year): −7.4 (−12.5 to −2.3) Mortality (4 weeks): Int 8% vs. Con 18% ($p = 0.048$)	4 weeks duration (total 13 h), commencing within 24 h of return to facility	Usual care

DEMQOL Dementia Quality of Life measure, *diff* difference, *h* hour/s, *NHLSD* Nursing Home Life-Space Diameter, *physio* physiotherapist, *QoL* Quality of Life

Table 12.7 Trials of community-based exercise and mobility training programmes with demonstrated effectiveness on mobility or function[a]

Study	Participants	Intervention type	Setting	Effect size SMD (95%CI)	Programme dose[b]	Control group	Control programme dose[b]
Binder 2004 [65]	People ≥65 years, living in community, physically frail	Standard physical therapy, then high-intensity programme of balance, co-ordination and strength exercises with progressive resistance training added after 3 months	Hospital and community rehabilitation, small groups (2–5) led by physical therapist, indoors, USA	Mobility: 0.83 (0.37, 1.29) Function: 0.44 (0, 0.87)	24 weeks, 3 × pw, 45–90 min Total: 81 h	Home-based, low-intensity non-progressive, plus monthly group sessions and weekly 10 min calls	24 weeks, 3 × pw, time NR Total: U
Hauer 2002 [66]	Women aged ≥75 years, recent history of injurious falls	High-intensity progressive resistance training of functionally relevant muscle groups (70–90% max workload), progressive training of functions such as walking, stepping or balancing, started on discharge Additional physio two times week for 25 min	Hospital and community. Small groups (4–6) led by therapeutic recreation specialist, Germany	Mobility (3 months): 1.36 (0.45, 2.26)	12 weeks, 3 × pw, 135 min[c] Total: 81 h	Group-based, placebo motor activity e.g. flexibility exercise, ball games, memory tasks Additional physio two times week for 25 min	12 weeks, 3 × pw, 60 min Total: 36 h
Latham 2014 [68]	≥60 years, functional limitation, able to sit to stand without mobility aid, discharged from rehab ≤20 months of baseline	Home-based exercise, repeating simple functional tasks, using Thera-bands for resistance plus standing exercises using steps of varying height and weighted vests (based on INVEST [84] and Sherrington and Lord [74]). Included cognitive and behavioural strategies addressing exercise, fear of falling and goal setting	Hospital and home-based exercise taught over 3–4 visits of approx. 1 h by physical therapist, with fourth if necessary plus monthly phone calls, USA	Mobility (6 months): 0.33 (0.05, 0.61)	24 weeks, 3 × pw, 60 min Total: 72 h	Attention control, cardiovascular nutrition education by registered dieticians, frequency of contact matched to intervention group	—

(continued)

Table 12.7 (continued)

Study	Participants	Intervention type	Setting	Effect size SMD (95%CI)	Programme dose[b]	Control group	Control programme dose[b]
Stasi 2019 [76]	Community-dwelling, able to walk outdoors for two blocks	Progressive resistance, hip abductor strength training standing and side lying, resistance progressed with cuff weights and loop elastic bands, 2 × 10 reps, progressing to 3 × 15 reps, increasing from 40 to 55 min. Approx. 10 min extra per supervised session commencing week 4, commenced week 6 in control group	Hospital and community, additional intensive resistance programme per supervised session commencing week 4, Greece	Mobility: 3.36 (2.73, 3.99) Function: 1.28 (0.84, 1.72)	12 weeks, 7 × week, 40–55 min Total: 70 h	Standard physiotherapy, daily 1 week in hospital, 11 weeks at home 3 × week supervised, 4 × week independently. Additional resistance from week 6	12 weeks, 7 × pw, 30–45 min Total: 52.5 h
Sylliaas 2011 [77]	People ≥65 years, living at home, ≥23 on MMSE	Progressive resistance (3 × 15 reps at 70% 1-RM weeks 1–3, then 80% with reducing reps maintained at ≥8, increased 3-weekly), 3–6 months after fracture. 10–15 min bike or treadmill warm-up, then standing knee flexion, lunge, sitting knee extension and leg press. Knee flexion and lunge with loading if tolerated Plus advice to walk 30 min per day if tolerated	Two times weekly in outpatient clinic, supervised by physiotherapist, One time weekly home based, Norway	Mobility: 0.51 (0.17, 0.86) Function: 0.37 (0.03, 0.72)	12 weeks, 3 × pw, 45-60 min Total: 32 h[d]	Usual lifestyle, no restrictions on exercise activities	—
Sylliaas 2012 [78]	People ≥65, living at home, ≥23 on MMSE, completed intervention arm of Sylliaas 2011 (12 week programme)	Extended training following from Sylliaas 2011. Prolonged resistance training (at 80% 1-RM, increased 3-weekly), 6–9 months post-fracture. Exercise components as per Sylliaas 2011	One time weekly in outpatient clinic with physiotherapist, One time weekly home based, Norway	Mobility: 1.52 (1.06, 1.97)	24 weeks,[e] 2 × pw, 45–60 min Total: 53 h[d]	Usual lifestyle, no restrictions on exercise activities	—

AMT Abbreviated Mental Test, *h* hour, *equiv* equivalent between both trial arms, *h* hours, *max* maximum, *min* minutes, *MMSE* Mini-Mental State Examination, *pw* per week, *NR* not reported, *1-RM* one-repetition maximum, *SD* standard deviation, *SMD* standardised mean difference, *U* unclear, *wks* weeks

[a]With a minim PEDro score of 5 or more

[b]Calculated as 1 month = 4 weeks (thus 6 months = 24 weeks)

[c]Including breaks

[d]Determined based on average session time of 52.5 min

[e]12 weeks plus previous 12 week programme of Sylliaas 2011

A more recent hospital-based trial has demonstrated effectiveness on a range of person-centred outcomes including mobility, function and quality of life at 1-year follow-up in comparison to standard orthopaedic care [40]. This programme provided comprehensive interdisciplinary care, early mobilisation and rehabilitation and also addressed psychosocial aspects of care through a focus on social situation and mental health.

Two exercise programmes that have demonstrated effectiveness in terms of improving mobility or function were delivered completely in an in-hospital (rehabilitation) setting (Table 12.5) [30, 31]. One study added progressive resistance training in the form of additional early post-operative, high-intensity bilateral quadriceps muscle strengthening to conventional physiotherapy. A significant improvement in the Elderly Mobility Scale, leg extensor power of the fractured leg and functional reach was reported at 16 weeks, which was 10 weeks after the end of the intervention [30]. The other programme which delivered a high dose of in-patient rehabilitation including supervised balance exercises (five times weekly for 90 min, over 3 weeks), also demonstrated improvements in mobility and function compared to standard rehabilitation on discharge [31].

12.6.2 Rehabilitation in the Community

Six multidisciplinary interventions delivered across both hospital and community settings have demonstrated improvements in patient-centred outcomes in comparison to usual orthopaedic care (Table 12.4) [37, 50–53, 55]. Four of these trials were conducted in high income countries [37, 52, 53, 55] and two were conducted in Taiwan [51, 81]. In general, multidisciplinary programmes that emphasise early assessment through comprehensive geriatric assessment with appropriate early surgery, early mobilisation, higher doses of mobility training and an emphasis on regaining functional independence are more effective. Multidisciplinary rehabilitation programmes (including those with a focus on multidisciplinary factors where specialist teams are not available) should also begin soon after hospital admission and continue for a long period, including after hospital discharge.

It remains unclear what is the best link between orthogeriatric services and hip fracture rehabilitation services to improve coordination for patients, but common governance structures, shared staff, shared information systems or formal arrangements for handovers are all options. These services should treat patients with dementia and delirium and also include patients who are living in, or will live in, residential aged care facilities. High intensity and prolonged multidisciplinary rehabilitation programmes (e.g. Singh et al. [52]) are effective for a selected group of people with hip fracture.

There is an emerging view that hip fracture rehabilitation programmes should also be available to people with significant dementia who live in long-term care, or at home, with severe disabilities. A recent trial of a four-week multidisciplinary programme delivered as a hospital outreach programme within long-term care demonstrated improvements in mobility at the end of the programme, which was not maintained over 12 months, but a small improvement in quality of life was observed at 12 months (Table 12.6) [56]. Whilst the programme was found not to be

cost-effective, it demonstrates that improvements in patient-centred outcomes can be made after hospital discharge in a population living in long-term care.

As shown in Table 12.7, the exercise programmes that continued after discharge and were effective were programmes conducted over 12–24 weeks. At least for some individuals, there are benefits from exercise programmes delivered after discharge from hospital. One of the most effective programmes identified in our review of trials of exercise and mobility training programmes was implemented as twice-weekly sessions with a physiotherapist in an outpatient clinic for the first 3 months, then once weekly for a further 3 months (Table 12.7) [77, 78]. This was supplemented with exercises once a week at home. The exercise programme involved prolonged progressive resistance training, fitness warm-up and lower limb strength exercises, compared to a control group of the participant's usual lifestyle, without any restrictions placed on the amount or type of exercise undertaken. This programme significantly improved patient's mobility after 3 months [77], but the magnitude of the effect was even greater after 6 months [78]. While the strength of effect in this study may partly be due to a comparison against patients with no structured exercise programme, two other community-based programmes of progressive resistance training in small groups also demonstrated large effects in comparison to alternative programmes [65, 66]. Another study has demonstrated that extra progressive resistance exercises in addition to a 12-week standard daily physiotherapy programme can provide additional benefits for mobility and function [76].

However, long-term provision of exercise programmes through outpatient clinics for whole populations may not be feasible, even in developed countries, as this would require an enormous expansion of rehabilitation services with associated costs. Greater provision of community exercise options in liaison with health professionals may help to meet this gap, as has been recommended for people with neurological impairments [82].

12.6.3 Rehabilitation in Low Resource Settings

A trial conducted in Taiwan has demonstrated significant improvements in mobility and self-care extending to 2 years post-hip fracture from interdisciplinary rehabilitation programmes in comparison to usual care with no formal rehabilitation programme [81]. A further trial demonstrated additional benefits of a comprehensive care programme addressing nutrition, depression management and falls prevention in addition to interdisciplinary care in the same setting [51]. Whilst the same interdisciplinary care may not be possible in low resource and LMIC settings, rehabilitation programmes that address these principles using professionals with competencies in geriatrics, orthopaedics, physiotherapy, occupational therapy, nutrition, social work and psychology should be the aim.

Supervised exercise programmes may present access difficulties for people in remote locations or in low resource settings so home exercise, wider family involvement or tele-rehabilitation options may be required.

A home-based exercise programme of simple, functionally oriented tasks with minimal supervision had a moderate effect on improving physical function [68]. In

this programme, a physical therapist taught the exercises and used cognitive and behavioural strategies to enhance attitudes and beliefs about the benefits of exercise and to overcome fear of falling during three home visits of 1 h (Table 12.7). Monthly telephone calls were also made by the therapists and an additional visit was provided if necessary. The participants were provided with a DVD of the programme to watch and a DVD player if necessary. Participants performed the exercises independently in their own home three times a week for 6 months, supported by a monthly telephone call from the physical therapist. The intervention also included a cognitive-behavioural component in order to improve adherence. A secondary analysis of this trial indicates that self-efficacy may partially mediate the effects of this intervention on longer term functional outcomes [83]. Whilst physical therapists may not be available in all resource settings, this trial demonstrates the potential effectiveness of home-based therapy. Alternative professionals with skills in physical therapy could provide training. Including caregivers in this training, where resources for watching a DVD and follow-up phone calls are not available, appears promising and warrants investigation.

12.7 Rehabilitation and Cognitive Impairment

Rehabilitation for people with dementia after hip fracture is complex. Approximately 40% of patients who sustain a hip fracture have dementia [85, 86]. These patients have more complex care needs, with greater risks of complications, physical disabilities and social care requirements compared to people without dementia [87]. This is due to a number of factors. Firstly, people with dementia are often more disorientated in hospital environments, being more prone to delirium. They often have difficulty expressing problems of pain, nausea and dizziness which impact on physical performance. Many people with dementia have movement limitations, which when combined with hip fracture, makes simple tasks like learning how to use walking aids and equipment very difficult. They often have a critical relationship with informal caregivers (family/friends) which is strained after a hip fracture; greater considerations for supporting the patient–caregiver dyad may be required than for patients without dementia. Daily proactive geriatrician visits starting before or within 24 h of hip fracture surgery, with application of multiple types of treatment, has been demonstrated to reduce delirium occurrence by 36%, and severe delirium by 60% [38]. Similar principles could be followed in LMIC settings with lesser intensity of inputs.

A number of research reports and guidelines recommend intervention with specific strategies including enhanced rehabilitation and care pathways to support recovery from hip fracture for people living with dementia. However, the evidence base for these is sparse. Five trials have investigated enhanced rehabilitation models for this population; evaluating strategies designed specifically for people with dementia following hip fracture surgery. These are larger trials of patients following hip fracture surgery which have presented data specifically for the subgroup of patient with cognitive impairment. These trials have tested two types of interventions: enhanced interdisciplinary inpatient rehabilitation and care models versus conventional

inpatient rehabilitation and care models [43, 88, 89] and secondly, enhanced interdisciplinary inpatient and home-based rehabilitation and care models versus conventional rehabilitation and care models [90, 91]. The characteristics of these trials and interventions are presented in Table 12.8. The enhanced models generally offer multidisciplinary programmes with greater intensity or length of programmes.

Table 12.8 Characteristics of trials of enhanced rehabilitation for people with dementia following hip fracture

Study	Setting country	Sample size	PEDro	Characteristics of intervention	Comparator
Hospital-based enhanced rehabilitation programmes					
Freter 2017 [88]	Hospital, Canada	283	4	Delirium-friendly care options including: Orientation strategies; night-time sedation, analgesia, and nausea; attention to catheter removal and bowel movements	Standard recovery programme
Stenvall 2012 [89]	Hospital, Sweden	64	6	MultiD team intervention: Individual care planning, monitoring for specific common complications (falls, delirium, bowel and bladder care, sleep, pain, pressure sores, physiological markers and nutrition), early inpatient rehabilitation with increased staffing ratio	Non-formalised and inconsistent provision of team working, individualised care planning, rehabilitation or complication monitoring. Prevention and treatment of decubitus ulcers, pain management and basic care, but no dietitian review
Uy 2008 [43]	Hospital, Australia		8	Early mobility and self-care (nurse delivered). Target of twice-daily physiotherapy with greater multiD team involvement in mobility and enablement	Standard recovery programme
Hospital- and community-based enhanced rehabilitation programmes					
Huusko 2000 [90]	H&C Finland	141	7	Enhanced multi D team rehabilitation including two times daily physiotherapy, multiD team meetings and improved communication across the team and with patients. Plus discharge planning and ten home-based physiotherapy sessions	Standard recovery programme. All participants encouraged to mobilise on the first post-operative day. No further information provided
Shyu 2012 [91]	H&C Taiwan	160	6	Enhanced multiD team, two times daily physio, multiD team meetings, improved communication and individualise care. Plus individualised discharge planning, three home-based physio and eight home-based nurse visits	Standard recovery programme. Inpatient rehabilitation consisted of 3 physiotherapy sessions, and no in-home rehabilitation. No further information provided

C community, *H* hospital, *H&C* hospital and community, *MultiD* multidisciplinary, *physio* physiotherapy

12.7.1 Enhanced Interdisciplinary Inpatient Rehabilitation and Care

The clinical outcomes of enhanced inpatient rehabilitation care compared to conventional care are summarised in Table 12.9. It appears there was no benefit of enhanced interdisciplinary inpatient rehabilitation over conventional care for outcomes including personal ADL independence at four-month or 12-month follow-up, walking independence without an aid or assistance at four-month or 12-month

Table 12.9 Clinical outcomes of enhanced rehabilitation interventions for people with dementia following hip fracture

Outcome measure	Time-point (months)	Participants	Study	Outcome OR/MD (95% CI)
In-patient enhanced rehabilitation programmes				
Personal activities of daily living independence	4	54	Stenvall 2012 [89]	OR 4.14 (0.40–42.66)
	12	47	Stenvall 2012 [89]	OR 4.62 (0.18–119.63)
Walking independence without an aid or assistance	4	54	Stenvall 2012 [89]	OR 7.63 (0.83–70.53)
	12	47	Stenvall 2012 [89]	OR 7.20 (0.74–70.42)
Mortality	Discharge	151	Freter 2016; Stenvall 2012; Uy 2008 [43, 88, 89]	OR 0.62 (0.22–1.74)
Hospital Length of Stay	Discharge	141	Freter 2016; Stenvall 2012 [88, 89]	MD −3.24 (−8.75 to 2.26)
In-patient and community-based enhanced rehabilitation programmes				
Mortality	3	184	Huusko 2000; Shyu 2012 [90, 91]	OR 1.20 (0.36–3.93)
	12	177	Huusko 2000; Shyu 2012 [90, 91]	OR 1.07 (0.47–2.45)
Requirement of institutional care	3	184	Huusko 2000; Shyu 2012 [90, 91]	OR 0.46 (0.22–0.95)
	12	177	Huusko 2000; Shyu 2012 [90, 91]	OR 0.90 (0.40–2.03)
Regained their pre-fracture walking capability	3	43	Shyu 2012 [91]	OR 5.10 (1.29–20.17)
	12	36	Shyu 2012 [91]	OR 58.33 (3.04–1118.19)
	24	30	Shyu 2012 [91]	OR 3.14 (0.68–14.50)
ADL performance	3	43	Shyu 2012 [91]	MD 18.81 (9.40–28.22)
	12	36	Shyu 2012 [91]	MD 25.40 (10.89–39.91)
	24	30	Shyu 2012 [91]	MD 7.92 (−9.88 to 25.72)
	12	36	Shyu 2012 [91]	OR 0.20 (0.01–4.47)
	24	30	Shyu 2012 [91]	OR 0.77 (0.16–3.74)

CI confidence interval *MD* mean difference *OR* odds ratio

follow-up or the number of drugs prescribed on discharge. Similarly, there were no differences in outcomes for mortality or hospital length of stay for enhanced inpatient rehabilitation models over conventional care.

There was no benefit of an enhanced inpatient rehabilitation programme over conventional rehabilitation for complications including pneumonia, pressure ulcers, post-operative fracture or whether participants were living in care facilities at 4 months or 12 months. However, there was a reduction in the enhanced interdisciplinary rehabilitation care model group for complications including urinary tract infection, nutritional problems, recurrent falls and post-operative delirium. Freter and colleagues also reported greater cognitive function for those who received the enhanced intervention 5 days post-operatively compared to conventional rehabilitation [88].

12.7.2 Enhanced Interdisciplinary Inpatient and Home-Based Rehabilitation

The clinical outcomes of enhanced rehabilitation inpatient and home-based rehabilitation care compared to conventional care are summarised in Table 12.9. Findings suggest that enhanced inpatient and community-based interventions for people with cognitive impairment provide promising early outcomes, but do not differ to conventional rehabilitation models longer term. Whilst people allocated enhanced interdisciplinary rehabilitation were less likely to be living in institutional care at 3 months, this was less certain at 12 months. One trial conducted in Taiwan reported that patients who received enhanced rehabilitation strategies until 3 months post-discharge had improvements in regaining pre-fracture walking levels and better ADL performance at 3 and 12 months, but did not differ from conventional rehabilitation at 24 months [91]. The evidence suggests no benefit of the enhanced inpatient and home-based intervention for outcomes including frequency of hospital admissions, attendance at the emergency room/accident and emergency, incidence of falls or mortality at 4 or 12 months post-operatively.

Whilst the current evidence-base provides a basis, the data remain very low in quality due to the small number of participants and the serious risk of bias in trial designs. The evidence underpinning the rehabilitation of people with dementia following hip fracture is based on subgroup analyses of randomised controlled trials of people with and without cognitive impairment who have a hip fracture. Consequently, the evidence-base is underpowered. No data were provided on behaviour, quality of life, pain or complications. No trials have investigated interventions which have been specifically designed for people with cognitive impairment. It remains unclear whether rehabilitation models are more effective if they include dementia-focused interventions such as provision of cues, reminiscence therapy, the adoption of familiarised routines or the use of assistive technologies. These are areas of research priority. Following this, it is hoped that health professionals will be able to be more evidence-based in addressing the complex care needs for this subgroup of the hip fracture population.

Nevertheless, it is clear that patients with cognitive impairment also benefit from rehabilitation approaches and these patients should not be excluded from rehabilitation following hip fracture.

12.8 Psychosocial Factors and Rehabilitation

Within the WHO ICF framework, psychosocial factors can be environmental or personal "contextual" factors (e.g. social support, self-efficacy, fear of falling) or psychological "body function" factors (e.g. mental health) that interact with health conditions to impact on a person's functioning and recovery. Psychosocial factors are predictors of hip fracture recovery and their role in functional recovery after hip fracture has been acknowledged as important [92]. Depressive symptoms post hip fracture increase the likelihood of poorer mobility, function and psychological outcomes [92–94]. Fear of falling is common in people with hip fracture and is associated with poorer recovery, decreased mobility, anxiety and falls-related self-efficacy [95–97]. Social support and caregiver responses also appear to play a dynamic role in recovery [98, 99]. However, the relationships between psychosocial factors, rehabilitation programmes and outcomes are complex and inadequately understood.

Clinicians need to support patients' adjustment to residual disability when providing rehabilitation to people with fragility fractures. Hip fractures are common and many older people in the community hold the fear that a hip fracture will precipitate a move into a residential aged care facility. In an Australian time–trade-off study, 80% of community-dwelling women at risk of hip fracture said they would rather die rather than suffer a hip fracture requiring relocation into a residential aged care facility [100]. The participants of this study commonly believed that they were living on "borrowed time" having survived beyond usual life expectancy. They perceived any threat to their ability to live independently in the community as potentially catastrophic.

When individuals experience changes in their health states, they often alter their internal standards, their values and concept of quality of life which is sometimes described as a "response shift" [101]. After a hip fracture, many people are left walking with an aid, with restrictions in the use of public transport, hobbies and roles, thus a significant loss of quality of life may occur. Maximising functional recovery is important but providing adequate support for older people to make "response shifts" and adjustments and to identify ways to compensate for changes is equally important e.g. by acknowledging losses in mobility but providing access to alternatives.

A randomised controlled trial of a home-based hip fracture rehabilitation intervention which included psychological strategies improved mobility outcomes for patients [68, 83]. The study found that the intervention protected against the loss of self-efficacy. As self-efficacy appears to play a crucial role in maintaining exercise long-term, a focus on self-efficacy in hip fracture interventions may mean that

patients are more likely to continue activity independently [83]. Qualitative studies indicate that hip fracture patients recognise the importance of their own psychological outlook and the need for social support in their recovery. Support from health professionals provides not only information and exercises but also emotional and motivational support and confidence boosting. Support from informal caregivers, family and friends is also seen as invaluable to help with ADLs, emotional support, encouragement and companionship [95, 102, 103]. Thus, inclusion of psychological and social interventions in hip fracture rehabilitation programmes is likely to be beneficial. However, the specifics of how to best design such programmes to improve outcomes are yet unclear [92].

12.9 Delivery of Rehabilitation Following Hip Fracture in LMICs

The prevalence of hip fracture is expected to increase dramatically in middle-income countries in Asia and Latin America, presenting a major challenge to rehabilitation care in coming years. By the year 2050, around 30% of the world's hip fractures will occur in Asia, mostly in China and India. Although the rate of increase in incidence of hip fracture has been attenuated in Hong Kong and Taiwan, it has markedly increased for almost all age groups in both genders in mainland China [104]. India lacks a systematic data registry for fragility hip fractures, but a report in 2004 estimated an annual prevalence of 600,000 hip fractures, which will substantially increase, since the population over 60 years in 2026 will reach nearly 170 million people [105].

Overall hip fractures in the Latin America region will increase by 700% in the population 65 and over with an estimated cost of $13 billion [106]. Based on population ageing estimates in Brazil the increase of hip fracture prevalence is estimated to be nearly 250% between 2015 and 2040 [107]. In Mexico, another highly-populated country, hip fracture rate estimates are sparse, but one study showed similar rates to southern countries in Europe [108].

The impact of hip fractures is unfavourable for patients and their families in LMICs as many do not have health care systems which are able to deliver integrated services including rehabilitation. Barriers exist in terms of human resources capability, infrastructure, cultural and social influences and environmental context.

While research on barriers and facilitators for rehabilitation following hip fracture is still scarce in most LMICs, Tables 12.10 and 12.11 describe known barriers to prompt in-hospital and community rehabilitation following hip fracture surgery in LMICs.

Table 12.10 Barriers to prompt in-hospital rehabilitation following hip fracture surgery in LMICs

Barrier category	Items	Examples
Environmental context and resources	*Delayed surgery* • Long distances to find a proper trauma centre • Lack of ambulance service in rural areas • Overwhelmed public hospitals (scarcity of beds) • Fixed operative days of surgeons • Multiple poorly controlled comorbidities • Bias against admitting frail patients with multiple co-morbidities, pressure sores and those who carry high risks for surgery *Delayed or insufficient mobilisation and functional independence training* • Surgeon's choice of a conservative approach e.g. restricting weight-bearing • Lack of human resources (physiotherapists, occupational therapists, nurses) • Surgery on Fridays with no physiotherapists on weekends • Lack of co-management by orthopaedic and geriatric medicine (geriatric wards or comprehensive geriatric care units or geriatric consulting services) • Lack of in-patient rehabilitation services • Lack of falls prevention programmes *Lack of coordinated discharge plan and referral* • Fragmentation of services and poor transition home programmes. • Lack of caregiving training programmes prior to discharge	Presentation and surgery times: *India:* Patients travelled a mean of 86.4 km to trauma services; 86% patients presented to hospital ≥1 day after fracture (mean 18 days), 10% operated in ≤24 h [109] *Colombia:* 52% patients operated in 1–3 days, 40% 4–6 days, 8% ≥7 days [110] *Beijing*: 8% operated in ≤48 h [9] *Brazil:* Mean 3 days between fracture admission; waiting time for surgery 5.8 days. Nearly 70% operation >48 h [111] *Chile:* Time between admission and surgery 19.3 days, 7% surgery in ≤5 days [112] Assessment: *Colombia:* 64% not evaluated by physiotherapists in hospital [110] *Beijing:* 3.8% falls risk assessment, 22% orthogeriatric assessment [9] *India:* 10% fall-risk assessment, no orthogeriatric care [105] Rehabilitation: WHO: LMICs have scarcity of rehabilitation professionals, many have <10 skilled practitioners per one million population [113] Post-discharge: *Colombia:* Common complaint is lack of interventions to prepare families and patients for discharge to home [110] *China:* Most difficult tasks for family caregivers were providing assistance for stair climbing, emotional problems, management, walking training, rehabilitation and emergency disease management [114, 115]
Cultural and social	*Delayed surgery* • Lack of knowledge or information of family members about the urgency of a fall-injury event • Patients' beliefs in traditional bone healers and aversion to surgical interventions *Burden of family caregivers* • Low socioeconomic background and social vulnerability	*India:* Most patients and relatives had no knowledge of the consequences of hip fracture injury in older people [109] *Internationally:* Family financial overload related to medical appointments, private rehabilitation and transport [115]

(continued)

Table 12.10 (continued)

Barrier category	Items	Examples
Human resources capability	*Delayed surgery* • Untrained health care professionals in primary and secondary care services *Delayed mobilisation and functional independence training* • Evidence-based recommendation of early mobilisation, pain and delirium management, and fall risk assessment is not in routine care yet • Lack of training for nurses, physiotherapists and occupation therapists • Lack of a coordinated multidisciplinary approach • Failure to assess frailty and patients' previous and ongoing cognitive status with consequently limited access to appropriate and timely rehabilitation interventions • Poor attitude or bias against patients who are very old and/or with cognitive decline due to belief that outcomes will be disappointing and rehabilitation ineffective, thereby hopeless	*India and China:* Lack of falls assessment significant gap in care pathway for hip fracture in hospitals [105, 109] *Brazil:* Falls are the main cause of death during the first 30 days after surgery, representing 43.5% of deaths [116]

12.9.1 Key Evidence-Based Recommendations and Their Implementation in LMICs

Implementation of evidence-based recommendations in LMICs is challenging but should not be interpreted as a wasted effort. Table 12.12 lists some key evidence-based recommendations and suggestions for implementation of in-hospital rehabilitation and community rehabilitation following hip fracture surgery in LMICs, based on expert opinion. Suggestions with limited formal evidence but apparent face validity include involving families as partners early and explicitly including them in the care plan and ensuring that ward nurses and therapists jointly commit to delivering the mobility goals.

With limited infrastructure (rehabilitation units and trained therapists) and rapidly growing demand, disruptive approaches to rehabilitation are needed in LMICs. WHO's Integrated Care for Older People (ICOPE) programme for older people is a community-based primary care health ageing approach which focuses on ways of optimising a community dwelling older person's function. However, many of the tools and resources provided in this programme allow community workers to design

Table 12.11 Barriers to rehabilitation in the community in LMICs

Barrier category	Items	Examples
Environmental context and resources	Lack of comprehensive geriatric care services to conduct structured, systematic inter-disciplinary geriatric assessment (including physical and mental health, function and social support condition) Ineffective and under-utilised referral pathways to rehabilitation after hospital discharge No timely and affordable rehabilitation interventions (long waiting times) Lack of adequate service network and rehabilitation facilities to meet different rehabilitation needs (inpatient, outpatient and homecare) Lack of rehabilitation staff, particularly occupational therapists Poor adherence due to lack of transportation, inability of caregiver to take time off work and long distances to rehabilitation facilities Inadequate resources (assistive technologies and devices) Lack of standardised protocols for post-acute care Lack of accessibility and poor neighbourhoods preventing independence in walking outdoors	*Taiwan:* Community-based home care services are designed for people with long-term care needs and are mainly skilled nursing care—doesn't completely fit post-acute care needs [117] *Brazil:* 70% patients had ≤3 months rehabilitation after surgery, mostly one time weekly;[a] 17% had home care rehabilitation [118] *India and Brazil:* Physiotherapy largely delivered in acute care, access difficult in public services. Most families don't have resources to pay for private services *Brazil:* Majority of rehabilitation programmes based on the model of traditional clinic- and hospital-based settings, failing to reach frail older adults at home
Cultural and social influences	Negative social representation of old age Cultural attitudes and beliefs toward disability in old age, older adults have to be convinced that mobility related problems are treatable and falls can be prevented	*Brazil:* Negative connotations of age and a sense of passivity were experienced by older adults after hip fracture surgery, leading to immobility and inactivity (qualitative study) [95]
Human resources capability	Lack of training on systematic inter disciplinary geriatric assessment Lack of training on fragility fractures, frailty, sarcopenia and bone health Lack of training on evidence-based exercise approach (balance and resistance training and falls prevention) Lack of fracture liaison services with a multidisciplinary care approach	

[a]Secondary data from a clinical trial

individualised programmes for older people. Available as an app or on-line some of these practical approaches (e.g. on nutrition, polypharmacy, carer support) could be helpful for primary care workers once a patient with a hip fracture returns home (available from www.who.int/ageing/health-systems/icope/en/).

Table 12.12 Implementation strategies in LMICs, based on expert opinion

In-hospital rehabilitation evidence-based recommendations	Suggested implementation strategies
1. Comprehensive screening and assessment of older adults immediately after admission on trauma or orthopedic ward by a skilled trained nurse	• Make available a short, feasible, reliable and valid tool kit for nurses to screen for frailty and delirium • Identify poor nutritional status and dysphagia as early as possible • Take actions to overcome modifiable risk factors • Where orthogeriatric care is not routine, nurses should request a geriatric consultation for complex cases • Where rehabilitation team members are available (physiatrist, physiotherapist, occupational therapist and speech therapy) a multidisciplinary assessment should be conducted
2. Physiotherapy approach immediately after admission	If surgery is delayed, immediate physiotherapy should begin to prevent muscle strength decline of the non-fractured leg, avoid respiratory problems (such as pneumonia), and pressure ulcers
3. Include caregivers in the care planning from time of ward admission	Caregivers may request to stay with older adults in the ward and should be included in the care plan. Train caregivers to identify signs of complications (such as delirium, swallowing problems, falls, pain) and help with daily basic activities, this can build and strengthen their skills for hospital discharge. Empower caregivers as co-participants in care during hospital stay
4. Surgical planning should target early weight-bearing	Weight-bearing restriction in the post-operative phase should be avoided since it limits what a patient can achieve in terms of mobility and functional independence. Effective surgery allows early weight bearing
5. Early mobilisation after surgery (24 h after surgery)	Unless medically or surgically contraindicated, physiotherapists and/or nurses should sit patients out of bed, and walk as early as possible Care plans delivered co-jointly by nurses and physiotherapists can promote patients' mobility over the entire day
6. Early post-operative goal-directed mobilisation practice with balance and functional exercises	Begin progressive resistance exercises, weight-bearing exercises (unless contra-indicated) and balance exercises during hospital stay, starting as early as possible Some services in LMICs are based on early discharge from hospital to rehabilitation at home ("hospital at home"). Harness informal and formal caregiving training and use technology but be aware how to achieve the best results when relying on families as therapists in LMICs, particularly when education levels are low
7. Fall risk assessment during hospital stay	Provide falls risk assessments to patients/caregivers with educational information and referral to community services after discharge
8. Discharge planning	Nurses should prepare caregivers for the level of care at home. Educational materials and practical carer training should be provided where possible [119]

Access to rehabilitation with the associated opportunity to maximise function and quality of life is increasingly recognised as a human right. Efforts to increase therapist numbers and optimise older patients' access to evidence-based hospital rehabilitation programmes have been strengthened by WHO's recent Rehabilitation 2030: Call to Action [1]. But as the pressure increases for health systems to provide universal coverage with access to rehabilitation it is likely that community-based rehabilitation will become more important as a cost-effective way to deliver services. Globally, community rehabilitation is also likely to become the focus for future research efforts to maximise recovery, partly because of the long trajectories of recovery (particularly of mobility) after hip fracture and partly because older people are increasingly vocal about prioritising returning home as quickly as possible.

12.10 Conclusion

- A rehabilitation pathway includes: (1) early and intensive mobility and self-care retraining with medical minimisation of complications and problems from comorbidities; (2) chronic care interventions (including dementia and frailty assessment and falls prevention) and (3) access to community services, including aged care support services and allied health therapies.
- Patients with cognitive impairment should not be excluded from rehabilitation following hip fracture.
- Recovery time for different functional domains varies from less than 6 months for many activities of daily living and cognitive function to over a year for walking 3 m without assistance.
- Rehabilitation programmes should be multidisciplinary with integration of orthogeriatric and rehabilitation services, or include professionals with multidisciplinary competencies. They should include early comprehensive geriatric assessment, surgery and mobilisation, with higher doses of mobility training and an emphasis on regaining functional independence. Programmes should also begin soon after hospital admission and continue after hospital discharge.
- In-patient rehabilitation programmes should include goal-directed mobilisation practice with balance and functional exercises.
- Structured exercise programmes should continue beyond the hospital setting for at least 12 weeks and may include progressive resistance training.
- Exercise programmes should incorporate components targeting self-efficacy to support patients to build their confidence to undertake exercise programmes post-discharge.
- Where possible a chronic disease self-management approach should be used with patients and families to promote self-efficacy and adherence to falls prevention strategies, osteoporosis treatment and exercise programmes.
- Self-efficacy, social support and caregiver responses play a role in recovery and can assist in rehabilitation in hospital and at home. Caregivers should be included in every phase of the recovery e.g. during care and discharge planning.

- Whilst there are many barriers to providing rehabilitation services in lower to middle income countries, implementation of evidence-based recommendations should not be viewed as futile. Health care professionals at all levels should not accept cognitive and physical functioning limitations as a normal age-related pathway for older patients after hip fracture surgery.

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