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SYSTEMATIC REVIEW

Effectiveness of outpatient geriatric rehabilitation after inpatient geriatric rehabilitation or hospitalisation: a systematic review and meta-analysis

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Abstract

Background: Due to the increasing number of older people with multi-morbidity, the demand for outpatient geriatric rehabilitation (OGR) will also increase.
Objective: To assess the effects of OGR on the primary outcome functional performance (FP) and secondary outcomes: length of in-patient stay, re-admission rate, patients' and caregivers' quality of life, mortality and cost-effectiveness. We also aim to describe the organisation and content of OGR.
Methods: Systematic review and meta-analysis. Five databases were queried from inception to July 2022. We selected randomised controlled trials written in English, focusing on multidisciplinary interventions related to OGR, included participants aged ≥65 and reported one of the main outcomes. A meta-analysis was performed on FP, patients' quality of life, length of stay and re-admissions. The structural, procedural and environmental aspects of OGR were systematically mapped.
Results: We selected 24 studies involving 3,405 participants. The meta-analysis showed no significant effect on the primary outcome FP (activity). It demonstrated a significant effect of OGR on shortening length of in-patient stay ($P = 0.03$, MD = −2.41 days, 95%CI: [−4.61—0.22]). Frequently used elements of OGR are: inpatient start of OGR with an interdisciplinary rehabilitation team, close cooperation with primary care, an OGR coordinator, individual goal setting and education for both patient and caregiver.
Conclusion: This review showed that OGR is as effective as usual care on FP activity. It shows low certainty of evidence for OGR being effective in reducing the length of inpatient stay. Further research is needed on the various frequently used elements of OGR.

Keywords: outpatient geriatric rehabilitation, functional performance, length of stay, re-admission, quality of life, systematic review, older people

Key Points

- Geriatric rehabilitation is more frequently offered at home known as ambulatory or outpatient geriatric rehabilitation (OGR).
- OGR is effective in reducing the length of in-patient stay.
- OGR is as effective as usual care on functional performance activity, patients' quality of life, and re-admission rate.
- Further research is needed on the various frequently used elements of OGR.

Introduction

Older people with an acute decline in function or with subacute health decline in chronic diseases should be offered Geriatric Rehabilitation (GR) [1]. According to the European consensus, the definition of GR is 'a multidimensional approach of diagnostic and therapeutic interventions, to optimise functional capacity, promote activity and preserve functional reserve and social participation in older people with disabling impairments' [2]. Currently, GR is mostly provided in inpatient hospitals or skilled nursing homes. However, GR is evolving internationally and is more frequently offered at home, in an outpatient setting or in the patients' residence through a specialised multidisciplinary team (known as ambulatory or outpatient geriatric rehabilitation, OGR) [1].

Over recent years, the general intention of GR professionals and policymakers has been to shorten the inpatient phase of GR and continue rehabilitation in the home or an outpatient setting with the aims of cost-effectiveness and providing a high quality of care [3–5]. Earlier studies have discussed that well-structured OGR, offered in line with inpatient GR, may lead to effective rehabilitation outcomes and early discharge [6]. OGR appears to positively affect mobility, balance, risk of falling, self-employment and general health [7]. Task-oriented training in OGR improves the patient's functional outcome and quality of life [7, 8]. Furthermore, involving close relatives can reduce caregiver burden [9]. According to Nanninga et al. [8], caregivers have more confidence in guiding the patient in their daily functioning when that guidance is practiced at home.

Internationally, OGR is organised in different ways with some countries, e.g. Italy and Greece, not able to provide OGR at all, because of the health care finance system [1, 10]. Moreover, there is no consensus about the inclusion criteria for OGR [1, 10]. Multiple reports have indicated a need for further research into OGR [5, 11]. Unfortunately, evidence on the effectiveness of OGR is scarce and mainly focuses on stroke and hip fractures [1]. Additionally, there are many uncertainties about the various structures, processes and rehabilitation environments that may affect the quality and outcome of OGR. To manage the uncertainties regarding the content and organisation of OGR, the post-acute care (PAC) rehabilitation quality framework [12] can be useful to map these elements and to report on the quality of rehabilitation. This framework is based on two models that are widely used within healthcare: the Structure, Process, Outcome model of Donabedian [13] and the International classification of functioning disability, and health (ICF) model of the World Health Organisation (WHO) which includes the patient-centred aspect of rehabilitation [14].

Earlier research [1, 3, 6–8, 15, 16] indicated that OGR could have an impact on patients' functional performance (FP), total duration of rehabilitation, re-admission to hospital or a nursing home, patients' and caregivers' quality of life, mortality and cost-effectiveness. However, to our knowledge, there have been no studies that systematically mapped out the effects of OGR. Therefore, the present systematic review and meta-analysis assesses the effects of OGR on the primary outcome FP (activity and participation) and secondary outcomes: (i) length of in-patient stay, (ii) re-admission rate, (iii) patients' and caregivers' quality of life, (iv) mortality and (v) cost-effectiveness in comparison to usual care. Moreover, we aim to describe the organisation and content of OGR.

Methods

We performed a systematic review and meta-analysis according to the PRISMA (Preferred Reporting Items for Systematic reviews and meta-Analysis) statement [17]. This systematic review has been registered in the PROSPERO register of systematic reviews (registration number: CRD42021260264).

Search strategy

We conducted a systematic literature search in PubMed, Embase, CINAHL, Cochrane and Web of Science from their inception to July 2022. The search strategy was conducted by GB and AP. The following terms were used (including synonyms and closely related words): 'ambulatory', 'outpatient', 'geriatric', 'rehabilitation' and 'randomized controlled trial'. Appendix 1 shows the full search strategy. Additional trials were identified by screening the references of selected articles.

Study selection strategy

After removal of duplicates, title and abstract screening was performed independently by two reviewers (AP, AL). Whenever there was a lack of consensus, a third party was consulted (MP, MH). Next, the full text of all eligible studies was screened by two reviewers (AP, AL). We included studies that met the following criteria: (i) Design: randomised controlled intervention trials (RCTs). (ii) Intervention: related to OGR; rehabilitation at home and/or in an outpatient setting and coordinated by a multidisciplinary team with a duration at least three weeks. (iii) Population: people who have an acute decline in function, suffer from a (complex) disease or multi-morbidity in the sub-acute phase, living at home after an inpatient rehabilitation period. (iv) Outcome: at least one of the outcomes of OGR (FP, patients' and caregivers' quality of life (pQoL/cQoL), length of in-patient stay (i.e. acute care) in hospital and/or a post-acute in-patient setting prior to discharge to OGR (LOS), re-admission to hospital or a nursing home, mortality and cost-effectiveness). (v) Control: usual care; geriatric rehabilitation in an inpatient setting (hospital, stroke unit, skilled nursing home), home-based rehabilitation without multidisciplinary organisation, day rehabilitation, primary health care, discharge with no support or no follow-up. Studies were excluded based on the following criteria: age < 65 years, less than two involved disciplines or patients with chronic diseases in a stable phase.

Definition of FP

A definition of FP was used according to the ICF model and the WHO disability assessment schedule (WHODAS 2.0). FP can be divided into two categories: activity and participation. It states that 'functional performance activity (FPa) describes the execution of a task or action by an individual. It can be sub-divided into: a) cognition, b) mobility, and c) self-care. Functional performance participation (FPp) describes the involvement in a life situation. It can be sub-divided into: a) getting along, b) life activities, and c) participation' [14, 18].

Data extraction

Data extraction was completed individually by two reviewers (AP, AL). A data extraction form was developed based on the Cochrane Handbook for Systematic Reviews of Interventions [19]. For each study, the following data were extracted: study characteristics, participant characteristics, setting characteristics and outcome. If data were missing, we contacted the corresponding author by email.

Quality assessment

Two reviewers (AP, AL) independently assessed the risk of bias (RoB) in the studies using the Cochrane risk of bias tool for RCTs (RoB2) [20]. A third party (MH) was consulted when consensus could not be reached. When the original article did not contain sufficient information for the appraisal, the authors were contacted. Publication bias was assessed by visual inspection of funnel plots when at least 10 studies were included in the meta-analysis [21]. To determine the certainty of evidence, we applied the Grades of Recommendation, Assessment, Development and Evaluation (GRADE) approach to each meta-analysis (Appendix 5) [22, 23].

Data syntheses and analysis

Review Manager software (RevMan 5.4) [24] was used to perform the meta-analysis. We selected post-intervention outcome measures reported in at least five of the studies and for which sufficient data were available, such as mean and standard deviation. The embedded Review Manager calculator was used when standard deviations were missing, but *P*-values or 95% confidence intervals were given. Authors were contacted when data were insufficient. We used a random effects model, which assumes heterogeneity and expresses effects as standardised mean differences (SMD) or mean differences (MD) with accompanying confidence intervals. To examine statistical heterogeneity, we used the I^2, at which 50–90% may represent substantial heterogeneity. To examine study heterogeneity, we performed subgroup analyses based on diagnose-group. A sensitivity analysis was conducted by excluding studies with high RoB. [21]

Data synthesis was conducted in all studies using a harvest plot. For the outcomes FPp, cQoL, mortality and cost-effectiveness, the studies are coded based on whether there was no effect on the intervention, a favourable effect on the intervention or a favourable effect on the control group.

We performed a narrative synthesis [25, 26] to systematically summarise the specific OGR elements using the PAC rehabilitation quality framework [12]. This framework provides an overview of components of a patient-centred approach in PAC rehabilitation and how they interact. The process (patient-care, inter-professional) and immediate-intermediate outcomes (ICF) have an iterative and integrative connection which is influenced by the structure and environmental context elements. All the elements are related to the end goals of rehabilitation [12].

Results

Identification of eligible studies

The search identified 8,386 references. Figure 1 shows the Prisma flow chart. After screening by title and abstract, a total of 57 studies were considered for a full text review, where 18 studies were excluded due to various reasons (see Figure 1). A third reviewer was needed in eight cases to achieve consensus during the study selection process. Ultimately, 40 articles describing 24 studies were eligible for inclusion of which 8 were eligible for inclusion for the meta-analysis on FPa, 9 on LOS, 11 on re-admission and 5 on pQoL.

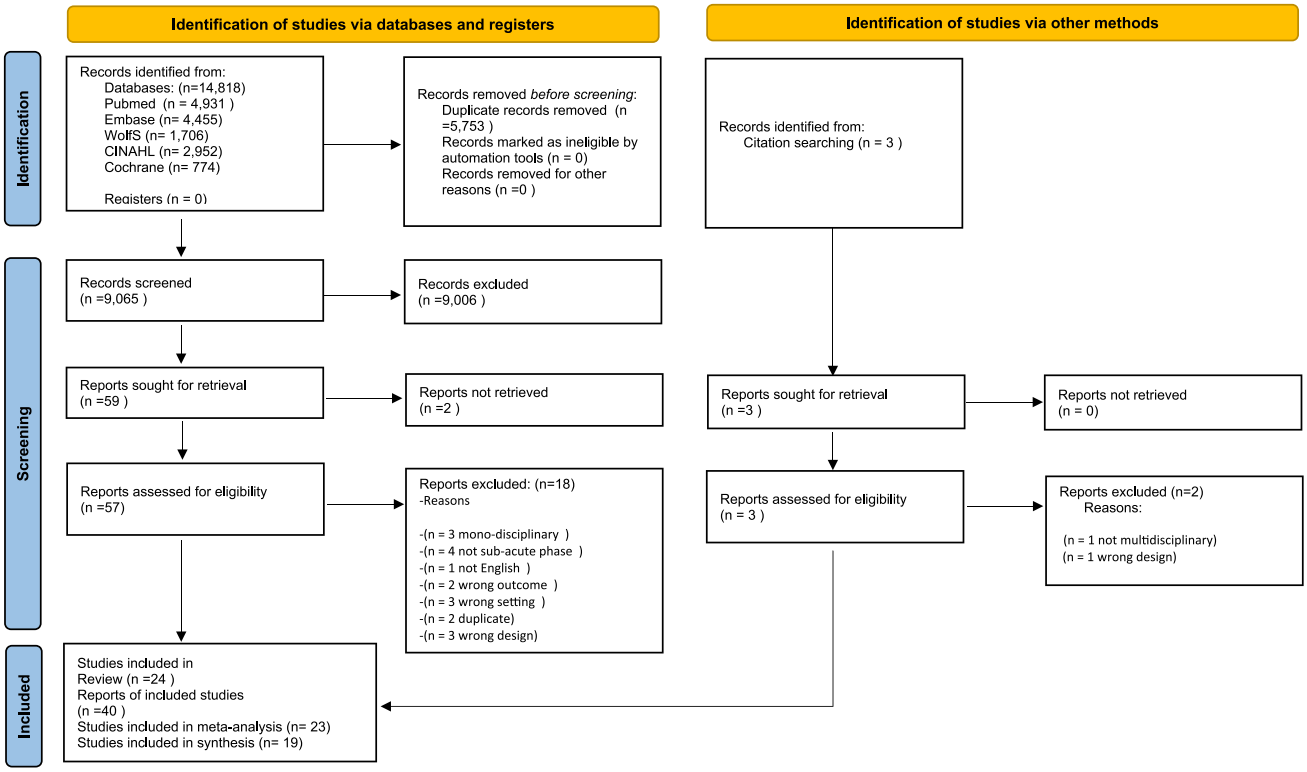


Figure 1. Flow diagram.

Study characteristics

The study characteristics are shown in Table 1. The number of participants in the 24 included studies totalled 3,405 allocated to the intervention ($n = 1{,}777$) or control ($n = 1{,}628$) group. The mean age ranged between 66.5 and 84.0 years. We found 15 studies (62.5%) on stroke [27–51], 5 (20.8%) on general GR [52–57], 3 (12.5%) on hip fractures [58–65] and 1 (4.1%) on COPD [66]. Baseline functioning of the participants was measured in 17 of the studies with the (modified) Barthel Index, whereas most studies included participants with moderate dependency [67].

Risk of bias assessment

Results of the RoB assessment are documented in Appendix 2. A summary of the overall result is presented in Table 2. In general, there is a low RoB arising from the randomisation process (100%), the missing outcome data (85%, $n = 34$), the measurement of the outcome (90%, $n = 36$) and the selection of the reported result (80%, $n = 32$). The RoB due to adhering to the intervention highlights 12 articles (30%) demonstrating a high RoB. In all of the studies, the participants and personnel were aware of the intervention. In many of the studies, the usual care intervention is not explained in enough detail, so it is not clear if the non-protocol interventions are balanced between the intervention and control group, and 45% of the 40 articles scored an overall high RoB. Visual inspection of funnel plots showed no indication of publication bias (Appendix 3).

Meta-analysis

Primary outcome

FP activity

Twenty-four studies assessed FPa. The effect of OGR on the Barthel Index (BI) [67] was assessed in 15 studies of which 8 [33, 39, 43, 44, 47, 49, 51, 64] were included in the meta-analysis (Figure 2A). The analysis was based on 1,038 participants (574 for intervention and 464 for control). There is no significant difference between OGR and usual care ($P = 0.32$). The certainty of evidence is low. There was a negligible effect (SMD) of 0.11 (95% CI: [−0.11–0.34]). There was significant ($P = 0.003$) and substantial heterogeneity ($I^2 = 67\%$). When excluding high RoB studies [39, 44, 49], the analysis also demonstrates no significant difference ($P = 0.72$) with a small effect size (SMD) of −0.04 (95% CI: [−0.27–0.19]). The heterogeneity reduced to $I^2 = 43\%$ ($P = 0.14$). The subgroup analyses did not alter the conclusion (Appendix 4).

Secondary outcomes

Length of in-patient stay

The length of in-patient stay (LOS) in hospital (acute care) and/or in an in-patient setting (PAC) before discharge to

Table 1. Characteristics of included studies

First author, year, country	Setting acute ➔ setting outpatient	Diagnosis: No. of patients (I/C)	Age mean (SD): Female % (I/C)	Living alone % (I/C)	Functioning at baseline (I/C): BI, mBI, Katz, FIM, NEADL	Cognitive (I/C) MMSE
Donald, 1995 [52]‡ UK	Hospital ➔ Hospital at home	Geriatric: 30/30	81.6 (5.4): 73.3 84.0 (6.0): 76.7	56.7/80.0	BI: mean (IQR) 15.9 (15–17)/15.7 (15–17)	NI
Rodgers, 1997 [27]‡ McManee, 1998 [28] UK	Hospital ➔Stroke discharge rehabilitation service	Stroke: 46/46	*73.0 (47–93): 43.0 73.0 (44–91): 48.0	48.0/46.0	BI: median (range): 15.0 (2–20)/13.0 (2–20)	NI
Holmqvist, 1998 [29]‡ Von Koch, 2000 [30]‡ Von Koch, 2001 [31] Thorsén, 2005 [32] Sweden	Hospital ➔Home rehabilitation	Stroke: 41/40	70.9 (7.6): 46.3 72.7 (8.9): 45.0	26.8/32.5	Katz ADL: 17.0/20.0	MMSE: median (IQR) 27.0 (26–29)/ 28.0 (26–28)
Baskett, 1999 [33]‡ New Zealand	Hospital ➔Supervised home-based program	Stroke: 50/50	67.8 (11.6): 46.0 71.7 (9.1): 40.0	NI	mBI: mean (SD) 86.8 (15.7)/87.6 (14.2)	NI
Anderson, 2000 [34]‡ New Zealand	Hospital ➔Early hospital discharge and home-based rehabilitation	Stroke: 42/44	72.0 (11): 38.1 71.0 (11): 50.0	40.5/43.2	mBI: median (IQR) 85.0 (80–97)/86.0 (77–95)	MMSE: median (IQR) 28.0 (25–29)/ 28.0 (77–95)
Indredavik,2000 [35]‡ Fjeartoft, 2003 [36], Fjeartoft 2004 [37] Fjeartoft 2011 [38] Norway	Hospital SU ➔(rehabilitation clinic ➔)Extended stroke unit service	Stroke: 160/160	¥74.0: 45.0 73.8: 56.0	41.0/43.0	mBI: mean (median) 60.4 (65.0)/ 58.5 (60.0)	NI
Mayo, 2000 [39]‡ Teng, 2003 [40]‡ Canada	Hospital ➔Early supported home-discharge	Stroke: 58/56	70.3 (12.7): 63.8 69.6 (12.7): 71.4	NI	mBI: mean (SD) 84.6 (14.4)/82.7 (13.9)	NI
Roderick, 2001 [41]‡ UK	Hospital ➔Domiciliary rehabilitation	Stroke: 66/74	*78.6 (62–91): 50.0 79.6 (60–95): 56.8	40.9/35.1	BI: mean (SD) 12.6 (4.4)/12.8 (5.0)	NI
Bautz-Holter, 2002 [42]‡ Norway	Hospital SU ➔Early supported discharge	Stroke: 42/40	*79.5 (69–84): 50.0 78.0 (74–82): 60.0	57.1/62.5	BI: median (IQR) 16.5 (12–19)/ 14.0 (11–18)	MMSE: median (IQR) 27.5 (24–29)/ 27.0 (22–30)
Crotty, 2002 [58]‡ Crotty, 2003 [59] Australia	Hospital ➔Early discharge with home-based rehabilitation	Hip fracture: 34/32	*81.6 (78.2–84.8): 62.0 83.5 (76.6–85.5): 75.0	44.0/34.0	mBI: median (IQR) 85.0 (79–89)/ 85.0 (77–89)	MMSE: median (IQR) 26.0 (24–29)/ 28.0 (27–29)
Askim, 2004 [43]‡ Norway	Hospital or rehabilitation clinic ➔Extended stroke unit service	Stroke: 31/31	¥76.9: 48.4 76.3: 45.2	35.5/48.4	mBI: mean (median) 57.7 (55)/54.0 (55)	NI
Cunliffe, 2004 [53]‡ Miller, 2005 [54] UK	Hospital ➔Early discharge rehabilitation service	Geriatric: 185/185 Fracture 28% Neurological 26% Cardio-respiratory 14% Musculoskeletal 8% Gastroenterological 5% Infection 4% Peripheral vascular 3% Other medical or surgical condition 2% Non-specific condition 11%	*80.0 (73–85): 71.0 79.0 (72–86): 62.0	69.0/65.0	BI: median (IQR) 15.0 (13–16)/15.0 (13–16)	NI

(*Continued*)

Table 1. Continued

First author, year, country	Setting acute ➔ setting outpatient	Diagnosis: No. of patients (I/C)	Age mean (SD): Female % (I/C)	Living alone % (I/C)	Functioning at baseline (I/C): BI, mBI, Katz, FIM, NEADL	Cognitive (I/C) MMSE
Caplan, 2006 [68]‡ Australia	Hospital ➔Home rehabilitation service	Frail older patients (ischaemic heart disease, diabetes, dementia) 64/33	83.9 (7.8): 61.4 84.0 (7.0): 64.7	NI	FIM: mean (SD) 100.3 (16.9)/ 78.9 (16.0)	MMSE: mean (SD) 22.7 (7.3)/ 23.2 (4.9)
Zidén, 2008 [60]‡, Zidén, 2010, [61] Sweden	Hospital ➔Home rehabilitation	Hip fracture: 48/54	81.2 (5.9): 60.4 82.5 (7.6): 77.8	54.0/72.2	NI	NI
Crotty, 2008 [56]‡ Australia	Hospital ➔Home rehabilitation	Geriatric: 113/116 Total knee replacement: 19%, Stroke: 44% home General rehabilitation (hip fracture, orthopaedic injury, functional decline) 37%	71.2 (13.4): 53.1 72.2 (14.8): 51.7	46.0/45.0	mBI: mean (SD) 92.2 (6.4)/ 92.5 (6.5)	MMSE: mean (SD) 27.0 (3.0)/ 26.9 (3.1)
Eaton, 2008 [66]‡ New Zealand	Hospital ➔Early inpatient-outpatient rehabilitation	Exacerbation COPD: 47/50	70.1 (10.3): 55.0 69.7 (9.4): 58.0	NI	NI	NI
Parker, 2011 [57]‡ UK	Hospital ➔Home-based rehabilitation	Geriatric: 47/42 Stroke 22% Falls assessment 27%, Mobility ass67 essment 21% Orthopaedic rehabilitation 9% Other reasons 20%	74.0 (11): 45.2 76.0 (11): 45.0	NI	NEADL: 15.0/16.9	NI
ESD stroke Bergen study: Hofstad, 2014 [44]‡ Gjelsvik, 2014 [45]‡ Taule, 2015 [46] Norway	Hospital SU or rehabilitation clinic ➔Early supported discharge day unit and early supported discharge home	Stroke: 207/99	*71.3 (27–92): 43.0 74.2 (32–98): 47.5	NI	mBI: median (IQR) 100.0 (50), 92.5 (35)/95.0 (45)	NI
Rasmussen, 2016 [47]‡ Denmark	Hospital ➔Early home-based rehabilitation before and after discharge	Stroke: 38/33	*78.0 (72–84): 58.0 79.0 (71–85): 58.0	NI	mBI: median (IQR) 57.0 (45–70)/ 54.0 (35–69)	NI
Santana 2017 [48]‡ Portugal	Hospital SU or rehabilitation clinic ➔Early home supported discharge	Stroke: 95/95	*67.5 (40–84): 51.0 66.5 (35–84): 43.0	NI	FIM: (SD) (min-max); 69.0 (21.3) (30–100)/70.5 (18.7) (24–100)	NI
Karlson, 2016 [62]‡ Berggren, 2019 [63]‡ Karlson, 2020 [64]‡ Karlson, 2020 [65] Sweden	Hospital ➔Geriatric interdisciplinary home rehabilitation	Hip fracture: 107/98	83.2 (7.0): 73.8 82.6 (6.4): 69.4	72.9/69.4	BI: median (IQR) 18.0 (13–20)/ 18.0 (13–20)	MMSE: mean (SD) 17.3 (8.4)/ 17.3 (8.9)
Rafsten, 2019 [49]‡ Sweden	Hospital ➔Very early supported discharge	Stroke: 69/71	75.5 (11.1): 39.1 72.7 (12.4): 38.0	NI	mBI: median(IQR) 82.5 (65–90)/ 80 (65–90)	NI
Vluggen, 2021 [50] Netherlands	Nursing home rehabilitation SU ➔Integrated multidisciplinary geriatric rehabilitation program	Stroke: 99/91	78.9 (7.0): 69.7 79.0 (6.5): 51.1	54.0/47.3	Katz-15: 6.0 (4.0)/6.5 (3.3)	NI
Kam Yuet Wong, 2022 [51] ‡ China	Hospital ➔home based transitional care program	Stroke 58/58	66.21 (10.07); 67.00 (8.61)	12.1/10.3	mBI; mean (SE) 83.86 (2.03) 87.93 (1.76)	NI

SU = stroke, unit I/C = intervention/control, NI = no information, geriatric diagnosis = mix of different diagnosis (stroke, orthopaedic, COPD, trauma and other), AMPS = assessment of motor and process skills, (m)BI = (modified) Barthel index, IPA = impact on participation and activity, MMSE = mini mental state examination, mRS = modified Rankin scale, NEADL = Nottingham extended ADL, CAPE = Clifton assessment procedure for the elderly; information/orientation sub-scale score < 8. ‡ = included meta-analysis. ¥ = SD not available. [a]Age median (range).

Table 2. Description of intervention

Author, year (colour indicates Risk of Bias)	Structure									Process												Environment		Outcome		
	Type of acute care setting			Type of OGR setting		OGR multi-disciplinary team			Facilities, external health-care	Amount and timing				Coordination of care		Specific intervention						Caregiver		Reported outcome *(measurement)*		
	Hospital	Rehabilitation clinic	OGR starts inpatient[1]	Patients' home	Day care/outpatient clinic	No involved disciplines	Community care members	Specialised from inpatient	Cooperation with primary care Facilitated transport	< 4 weeks	4–10 weeks	>10 weeks	Depending on needs	Case manager	Coordinator	Weekly team meeting	Individual goal setting	Task, context-specific training	Home visit during inpatient period	Self-training program	Education meeting for patient	Training/education meeting for caregiver	Participation and cooperation	Favours intervention	No difference	Favours control
Donald, 1995	X			X		4		X	X #		X				X							X		Du *(LOS)*, CE	FPa *(BI, FG)*,	Rea, Mor,
Rodgers, 1997 McManee,1998	X			X		5	X		X #				X		X	X			X				X	Du *(LOS)*, Mor, CE	FPa *(NEADL)*, Rea, pQoL *(CHG30)*, cQoL (*CHQ30*)	
Holmqvist,1998Von Koch, 2000, 2001 Thorsén, 2005	X			X		4		X				X		X		X	X	X		X			X	FPa (Katz), FPp *(FAI)*, Du *(LOS)*, CE	FPa *(BI, nhptest, 10mws)*, Du (*freq, du)*, Rea, Mort	
Baskett, 1999	X			X		2						X					X			X			X	DU *(freq)*	FPa (*BI, 10mws, nhptest, FAtest)*, Du *(LOS)*, pQoL *(HADS)*, cQoL (*CHQ28)*	Du *(du)*
Anderson, 2000	X			X		5	X		X						X	X	X			X				Du *(LOS)*	FPa *(mBI)*, FPp *(AAProfile)*, Rea, pQoL *(SF-36)*, cQoL *(CSI)*	
Indredavik,2000 Fjeartoft, 2003	X	X	X	X	X	3		X	X	X				X					X		X	X	X	FPa *(mRS)*, pQoL *(NHP)*	FPa (*BI)*, FPp *(FAI)*, Du *(LOS)*, cQoL *(CSI)*, Mor	
Fjeartoft, 2004, 2011																										
Mayo, 2000 Teng, 2003	X			X		5				X					X								X	Du *(LOS, freq)*, Rea, pQoL *(SF-36)*, cQoL *(CGB)*, CE	FPa *(OARS, BI)*, Mor	
Roderick, 2001	X			X		4	X						X				X						X		FPa*(BI, Rivermead mobiliy index)*, FPp *(FAI)*, Rea, pQoL *(SF-36)*, CE	
Crotty, 2001, 2003	X			X		7							X			X	X			X			X	FPa (*mBI)* Du (*LOS)*	FPa *(TUG, BBS, ABC)*, pQoL *(SF-36)*, cQoL *(SF-36, CSI)*	Du *(du)*
Bautz-Holter, 2002	X			X		3		X	X																FPa *(NEADL)*, Du *(LOS)*, pQoL, *(CHQ)*, Mor	
Askim, 2004	X	X	X	X	X	4		X	X	X							X		X				X		FPa *(mRS, BI)*, Du *(LOS)*, pQoL *(NHP)*,cQoL *(CSI)*, Mor	
Cunliffe, 2004Miller, 2005	X			X		6			#	X							X							Du (*LOS)*, CE	FPa *(BI, NEADL)*, Du *(du, freq)* Rea, pQoL *(EQ5D, CHQ)*, cQoL *(CHQ)*, Mor,	
Caplan, 2006	X			X		4		X					X				X							Du (*LOS)*, CE	FPa *FIM)*,Du *(du)*, Rea, Mor,	
Zidén, 2008,2010	X		X	X		4		X	X	X							X						X	FPa *(IAM, TUG,STS)*, FPp *(FAI)*, pQoL *(SF-36)*	FPa *(FIM)*, Du *(LOS, du, freq)*, Mor	

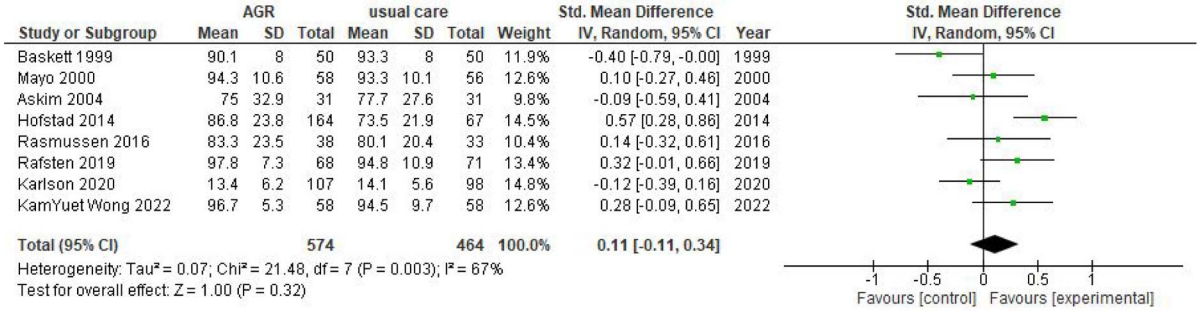
(*Continued*)

Table 2. Continued

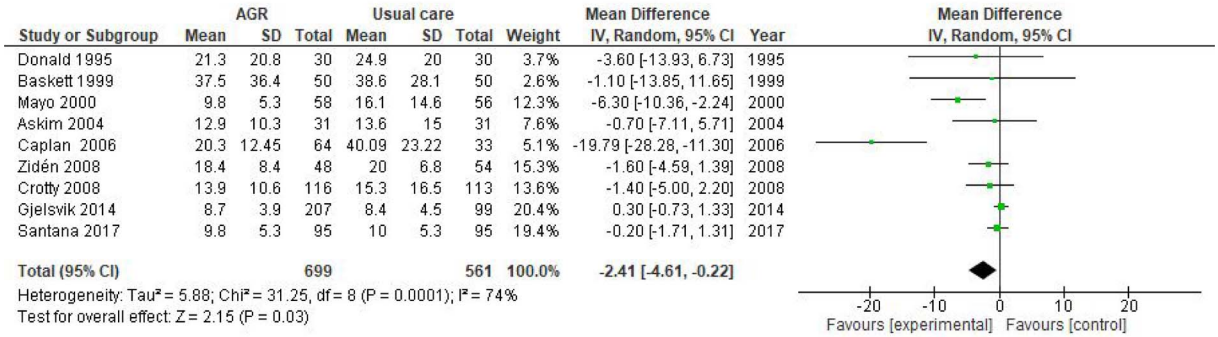
Author, year (colour indicates Risk of Bias)	Structure										Process												Environment		Outcome		
	Type of acute care setting			Type of OGR setting		OGR multi-disciplinary team			Facilities, external health-care		Amount and timing				Coordination of care		Specific intervention						Caregiver		Reported outcome *(measurement)*		
	Hospital	Rehabilitation clinic	OGR starts inpatient[1]	Patients' home	Day care/outpatient clinic	No involved disciplines	Community care members	Specialised from inpatient	Cooperation with primary care	Facilitated transport	< 4 weeks	4–10 weeks	> 10 weeks	Depending on needs	Case manager	Coordinator	Weekly team meeting	Individual goal setting	Task, context-specific training	Home visit during inpatient period	Self-training program	Education meeting for patient	Training/education	Participation and cooperation	Favours intervention	No difference	Favours control
Crotty, 2008	X			X		8						X					X	X							Du *(du)*, Rea	FPa *(AMPS, TUG)*, Du *(LOS, freq)*, pQoL *(SF-36)*, cQoL *(SF-36, CSI)*	
Eaton, 2008	X		X		X			X		X		X									X	X			Rea, pQoL *(SF-36, HADS, CRQ-SA)*	FPa *(6MWT)*, Du *(LOS)*,	
Parker, 2011	X			X		7																			QoLp *(HADS)*	FPa *(NEADL)*, Du *(LOS)*, Rea, pQoL *(EQ-5D)*, cQoL *(CHQ-30)*	
ESD stroke Bergen study; Hofstad, 2014 Gjelsvik, 2014, Taule, 2015	X	X	X	X	X	4	X	X	X			X							X		X				FPa *(NRS walking)*, Du *(freq)*	FPa *(mRS, BI, AMPS, FAC, TUG, 5mWS)*, Du *(LOS, du)*	
Rasmussen, 2016	X		X	X		4		X	X	X	X									X				X	FPa *(mRS)*, pQoL *(EQ-5D)*	FPa *(mBI)*, Du *(LOS, du, freq)*, Mor, CE	
Santana, 2017	X	X	X	X		4					X				X			X	X				X	X		FPa *(FIM)*, FPp *(FAI)*,Du *(LOS)*	
Karlson, 2016, 2020, Berggren 2019	X			X		6		X	X			X					X	X	X					X	Du *(LOS)*	FPa (*BI, Katz-ADL, walking ability)*, Du *(du, freq)*, Rea, Mor	
Rafsten, 2019	X		X	X		3		X	X		X							X					X	X	FPa *(mRS)*, pQoL *(HADS)*	FPa *(BI)*, Du (*du, freq)*,	
Vluggen, 2021		X	X	X		6		X	X					X		X	X	X				X	X	X	FPP *(IPA)*, cQoL *(self-rated burden)*	FPa *(Katz-15)*, FPP *(FAI)*, pQoL *(SSQoL)*, cQoL *(QoL-scale)*, Mor	
Kam Yuet Wong, 2022	X			X		6		X					X		X			X	X		X	X	X	X	pQoL *(EQ-5D)*	FPa *(mBI)*	

FPa = functional performance activity, FPp = functional performance participation, Rea = re-admissions, pQoL = patients' quality of life, cQoL = caregivers' quality of life, Mor = mortality, CE = cost-effectiveness, LOS = length of stay, inpatient before start OGR, du = duration of OGR, freq = frequency of therapy session. AMPS = assessment of motor and process skills, (m)BI = (modified) Barthel index, CRQ-SA = chronic respiratory questionnaire-self-administered, EQ5D = EuroQol 5D, FAC = functional ambulatory scale, FAI = Frenchay activity index, FIM = functional impairment scale, GHQ-30 = general health questionnaire, HADS = hospital anxiety and depression scale, IAM = instrumental activity measure, IPA = impact on participation and activity, LOS = length of inpatient stay before intervention, MMSE = mini mental state examination, mRS = modified Rankin scale, NEADL = Nottingham extended ADL, NHP-test = nine hole peg-test, NRS = numeric rating scale, NHP = Nottingham Health Profile, OARS = older Americans recourse scale for instrumental ADL, SF-36 = short form health survey, STS = sit to stand, SSQoL = stroke specific quality of life scale, TUG = timed up and go test, 5mTW = 5 meter timed walk, 10MWS = 10 meter walk speed. [1] Same team inpatient and in OGR, [#]General practitioner provides routine medical care

2A Barthel index. Note: GRADE certainty of evidence rated low due to substantial heterogeneity and high Risk of Bias



2B Length of in-patient stay. Note: GRADE certainty of evidence rated low due to substantial heterogeneity and high Risk of Bias



2C Re-admission. Note: GRADE certainty of evidence rated moderate due to high Risk of Bias

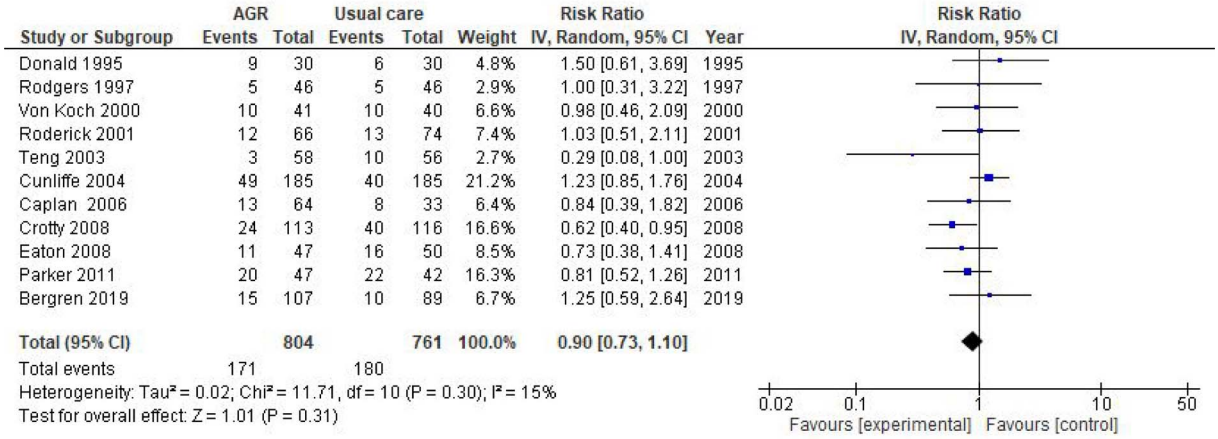
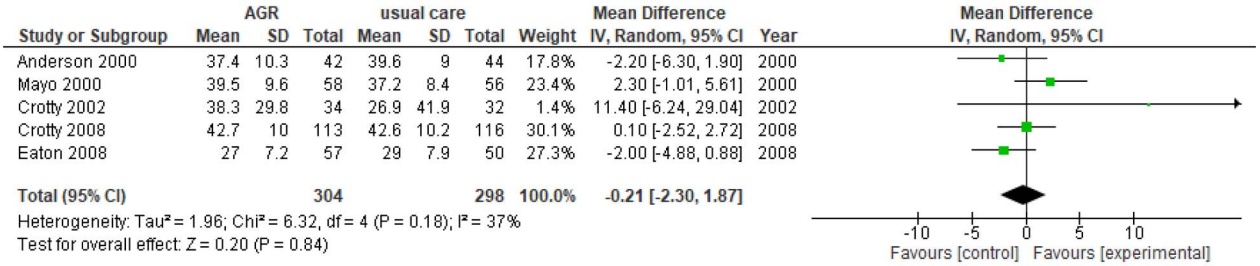


Figure 2. Meta-analyses 2A Barthel index. Note: GRADE certainty of evidence rated low due to substantial heterogeneity and high Risk of Bias 2B Length of in-patient stay. Note: GRADE certainty of evidence rated low due to substantial heterogeneity and high Risk of Bias 2C Re-admission. Note: GRADE certainty of evidence rated moderate due to high Risk of Bias 2D SF-36 physical health subscale. Note: GRADE certainty of evidence rated moderate due to high Risk of Bias 2E SF-36 mental health subscale. Note: GRADE certainty of evidence rated moderate due to high Risk of Bias.

2D SF-36 physical health subscale. Note: GRADE certainty of evidence rated moderate due to high Risk of Bias



2E SF-36 mental health subscale. Note: GRADE certainty of evidence rated moderate due to high Risk of Bias

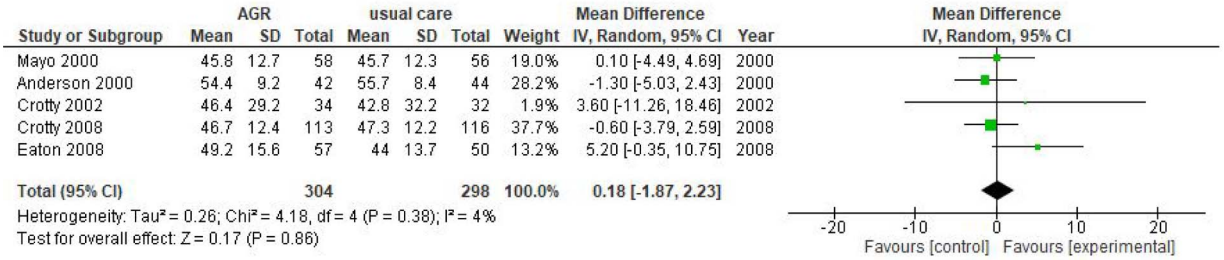


Figure 2. Continued.

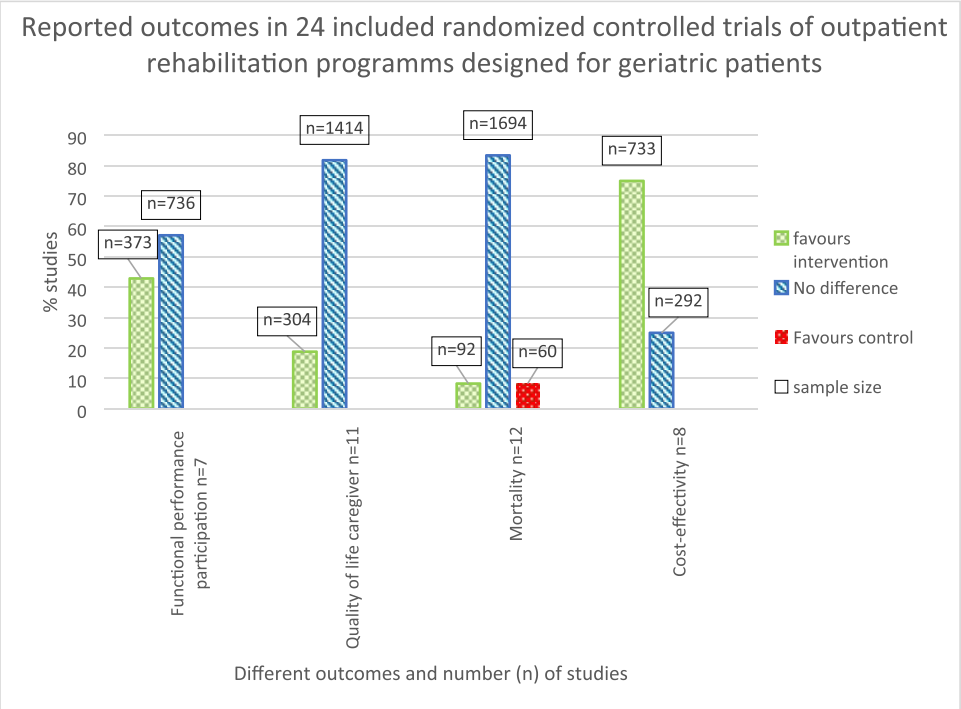


Figure 3. Data synthesis of reported outcomes on functional performance participation, caregivers' quality of life, mortality and cost-effectivity in 24 included randomized controlled trials of outpatient rehabilitation programms designed for geriatric patients.

OGR was assessed in 20 studies of which nine studies [33, 39, 43, 45, 48, 52, 56, 60, 68] were included in the meta-analysis (Figure 2B). The analysis was based on 1,260 participants (696 for the intervention and 564 for control). There is a significant difference between OGR and usual care ($P = 0.03$, MD = −2.41, 95% CI: [−4.61 to −0.22]). There was significant ($P = 0.0001$) and substantial heterogeneity ($I^2 = 74\%$). When excluding high RoB studies [39, 45, 52, 56, 68], the analysis demonstrates no significant difference ($P = 0.46$) with an MD of −0.50 (95% CI: [−1.81–0.81]). The heterogeneity reduced to $I^2 = 0\%$ ($P = 0.88$). The subgroup analyses did not show a significant difference between OGR and usual care (Appendix 4).

Re-admission

The number of re-admissions to hospital or a nursing home was measured in 11 studies [27, 30, 40, 41, 52, 53, 56, 57, 63, 66, 68] (Figure 2C). The analysis was based on 1,565 participants (804 for the intervention and 761 for control). It shows no significant difference ($P = 0.31$) with an RR of 0.90 (95% CI: [0.73–1.10]). The heterogeneity was low ($I^2 = 15\%$, $P = 0.30$). The subgroup analyses and the exclusion of studies with a high RoB [40, 41, 52, 53, 56, 57, 68] show similar effect (Appendix 4).

Patients' QoL

The pQoL was assessed in 18 studies. The effect of OGR on the Short Form health survey (SF-36) [69] was assessed in seven studies of which five [34, 39, 56, 58, 66] were included in the meta-analysis (Figure 2D and E). There is no significant difference between OGR and usual care on the patients' quality of life physical health ($P = 0.84$ MD: −0.21, 95% CI: [−2.30–1.87]) or mental health ($P = 0.86$ MD: −0.18, 95% CI: [−1.87–2.23]) subscales. The subgroup analyses and the exclusion of studies with a high RoB [34, 39, 56] did not alter the effect (Appendix 4).

Appendix 6 shows a narrative synthesis of FPa, LOS, re-admission and pQoL, of all included studies in this review.

Data synthesis

The harvest plot (Figure 3) shows overall no effect of the OGR intervention. The primary outcome FPp is reported in seven studies of which 43% ($n = 3$) demonstrated a favourable effect of the intervention, but 57% ($n = 4$) observed a neutral effect. Studies concluded that participants showed better autonomy and participated in more outdoor activities [32, 50]. The cQoL is reported in eleven studies of which 82% ($n = 9$) observed a neutral effect. Studies indicated that teaching and consultation possibilities can empower the caregiver to fulfil their supportive role [40, 50]The outcome of cost-effectiveness is an outlier, and 75% ($n = 6$) of the eight studies that reported cost-effectiveness show a favourable effect of the intervention. These studies [28, 31, 34, 40, 41, 54] concluded that a shorter inpatient period, less need of care and less re-admissions to hospital or nursing home might be causing this effect.

Organisation of the intervention

The specific structural, procedural and environmental aspects of the OGR programmes of the included 23 studies, plus the reported outcomes and measurements are summarised in Table 2.

Structure

The acute care setting before admission to OGR was mainly in a hospital setting (83%). The OGR programme started in nine (37.5%) studies during the inpatient rehabilitation period immediately after admission and the same multidisciplinary team followed the participants during the whole rehabilitation trajectory. The mean number of multidisciplinary team members was 4.7 (range: 2–8), which were specialised in GR in 14 (58.3%) studies. Co-operation with primary care had a prominent place in 12 (50%) studies.

Process

The duration of OGR shows great heterogeneity with a maximum duration ranging from 4 to 44 weeks. A 4-week duration was most common and occurs in eight of the studies (33.3%). Also, in nine (37.5%) of the studies, coordination of the OGR was performed by a team member acting as a case manager. Individual goal setting, mostly together with the patient, was applied in 14 (58.3%) studies.

Environment

In 15 (62.5%) studies, an active participation role and close cooperation with the caregiver was mentioned. Furthermore, in six (25%) studies, an education or training meeting was provided to the caregiver and focused on disease management, guiding the patient in daily activities and how to perform and supervise the self-training program.

Discussion

This systematic review aimed to present the effects of OGR on various outcomes and describe the organisation and content of OGR. We can conclude that OGR is as effective as usual care on the primary outcome FPa and secondary outcomes pQoL and re-admission rate. Furthermore, we demonstrated a positive effect on shortening the inpatient LOS; however, this result is not reflected in the subgroup analyses based on diagnosis-group and is based on low certainty evidence.

The data synthesis on the primary outcome FPp shows that the included studies reported comparable effects of OGR versus usual care. Remarkably participation was only used as an outcome in seven of the studies although the main goal of geriatric rehabilitation is to restore functioning and participation levels. It is known that after discharge from

an inpatient GR setting, older people face the consequences of disabilities in functioning and have trouble resuming participation in meaningful activities [15, 70, 71]. Possibly no difference is found because there seems to be too little focus on participation goals during rehabilitation which could enhance outcomes on participation level in outpatient rehabilitation [72, 73]. Therefore, we believe that focussing on participation goals starting inpatient and maintaining these in OGR could enhance outpatient rehabilitation.

In contrast to other outcomes, the data synthesis for cost-effectiveness demonstrated a favourable effect of the OGR intervention. However, the studies describing cost-effectiveness were mostly outdated and different calculation methods were used. Nevertheless, cost-effectiveness is important to demonstrate the added value of OGR [74]. Therefore, we recommend performing an economic evaluation alongside effectiveness studies in the future to gain better insight into the cost-effectiveness of OGR.

Unexpectedly, eHealth was rarely mentioned as a process element in the included studies. eHealth has become increasingly important in GR in recent years, and the added value has been presented in several studies. Pol et al. [75] have demonstrated positive effects using activity monitoring on top of cognitive behavioural OGR therapy on patients' reported daily functioning for people with hip fractures. Kraaijkamp [76] likewise shows positive results of blended eHealth applications and their feasibility within GR.

The reported overview of the organisation elements of OGR commonly used in the included studies can be used to further develop the organisation and content of OGR. The main difference between OGR and usual care is the rehabilitation environment. OGR mainly takes place at the patients' home with the advantage to stimulate and practice ADL activities in the own environment [9]. This could promote mobilisation and participation rehabilitation goals [77]. Still, we lack a precise description of the interventions including therapy exercises, intensity, frequency and place [78]. Moreover, it is not clear how the inpatient process can be adapted to achieve earlier and smooth discharge to OGR. We recommend performing multiple intervention studies to determine which elements are efficient, feasible and cost-effective in OGR. Additionally, future research is needed on structure, process and environmental elements of OGR from the perspective of patients, professionals and policymakers.

Strengths and limitations

The strength of this systematic review is the focus on patients requiring GR with various diagnoses. Many previous studies focused on the specific diagnosis group of stroke [1]; however, various diagnosis groups occur in OGR, and OGR must be applicable for them all [79]. Another strength is the focus on older people aged ≥65 with multi-morbidities. This group is often excluded from trials because of polypharmacy or multi-morbidities [80]. Nonetheless, these people qualify for OGR [1, 2]. To our knowledge, this review is the first to examine the effects of OGR specially designed for patients requiring GR.

This review also has limitations. First, the meta-analysis was only performed in four of the eight outcomes due to heterogeneity in the measurement scales used and little sufficient data were available. Yet, there is a low certainty of evidence as many studies had a high risk of bias or exhibited some concerns in one or more items, such as deviations from the intended intervention. This phenomenon was also found in the review of Handoll et al. [16] and is inherent to the type of study because blinding of the patients and carers is impossible in a rehabilitation setting. Secondly, the OGR interventions show substantial clinical heterogeneity, which could influence the strength of the meta-analysis [21]. It is questionable whether pooled analyses of and comparison between the different interventions is appropriate. Subgroup analyses on the diagnose-group showed similar results, although the number of studies was small, and therefore, no firm statements can be made [21, 81]. We still believe that it is appropriate to perform the meta-analyses because the wide variety of diseases is a hallmark of GR. In this study, we provide an overview of which elements are interesting to explore further. This study indicates that OGR is as effective as usual care and possibly more cost-effective. Further development of outpatient rehabilitation seems necessary given the challenges for future-proof care of older people.

Conclusion

Our systematic review shows that OGR is as effective as usual care on the primary outcome FPa and the secondary outcomes pQoL, and re-admission rate. Yet, we found low-certainty evidence for OGR being effective in shortening inpatient LOS. The data synthesis showed indications that OGR might be cost-effective. Additionally, it demonstrated various frequently used structural, procedural and environmental elements of OGR: (i) inpatient start and the same team provides rehabilitation at home, (ii) close cooperation with primary care, (iii) an OGR coordinator, (iv) individual goal setting and (v) an educational session to patient and caregiver. Future research is needed to reach consensus on the content and organisation of OGR and to determine which elements are efficient, feasible and cost-effective. In addition, more focus is needed on participation-level outcomes.

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