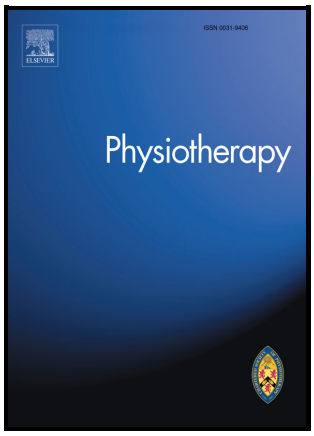

Frequency, duration, and type of physiotherapy in the week after hip fracture surgery - analysis of implications for discharge home, readmission, survival, and recovery of mobilityAnalysis of the English and Welsh Physiotherapy Hip Fracture Sprint Audit

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FREQUENCY, DURATION, AND TYPE OF PHYSIOTHERAPY IN THE WEEK AFTER HIP FRACTURE SURGERY - ANALYSIS OF IMPLICATIONS FOR DISCHARGE HOME, READMISSION, SURVIVAL, AND RECOVERY OF MOBILITY

Analysis of the English and Welsh Physiotherapy Hip Fracture Sprint Audit

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Ethical approval

The study did not require NHS Research Ethics Committee approval as it involves secondary analysis of linked pseudo-anonymised data.

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Conflicts of interest

The Chartered Society of Physiotherapy Charitable Trust funding provides salary support for AG, and partial salary support for SA. KS also received funding from the NIHR Research for Patient Benefit and UKRI Future Leaders Fellowship for hip fracture health services research. KS is the Chair and AJ and CG are members of the Scientific and Publications Committee of the Falls and Fragility Fracture Audit Programme which managed the National Hip Fracture Database audit at the Royal College of Physicians. FCM was the funded (2012-2018) board chair and AJ is funded clinical lead of the Falls and Fragility Fracture programme. SA is funded by the

NIHR Biomedical Research Centre based at Guy's and St Thomas' NHS Foundation Trust, King's College London. CS received funding from the National Institutes of Health Research for research not related to the current study. TS received funding from the National Institutes of Health Research for research not related to the current study. CLG receives funding from Versus Arthritis (ref 22086). ES is supported by the NIHR Applied Research Collaboration Wessex. The views expressed are those of the authors and not necessarily those of the National Health Service, the NIHR or the Department of Health and Social Care. OA, LB, IDC, BS, RMC, JM and MTK declare no conflicts of interest.

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ABSTRACT

Purpose

To examine the association between physiotherapy access after hip fracture and discharge home, readmission, survival, and mobility recovery.

Methods

A 2017 Physiotherapy Hip Fracture Sprint Audit was linked to hospital records for 5,383 patients. Logistic regression was used to estimate the association between physiotherapy access in the first postoperative week and discharge home, 30-day readmission post-discharge, 30-day survival and 120-days mobility recovery post-admission adjusted for age, sex, American Society of Anesthesiology grade, Hospital Frailty Risk Score and prefracture mobility/residence.

Results

Overall, 73% were female and 40% had high frailty risk. Patients who received ≥2 hours of physiotherapy (versus less) had 3% (95% Confidence Interval: 0-6%), 4% (2-6%), and 6% (1-11%) higher adjusted probabilities of discharge home, survival, and outdoor mobility recovery, and 3% (0-6%) lower adjusted probability of readmission. Recipients of exercise (versus mobilisation alone) had 6% (1-12%), 3% (0-7%), and 11% (3-18%) higher adjusted probabilities of discharge home, survival, and outdoor mobility recovery, and 6% (2-10%) lower adjusted probability of readmission. Recipients of 6-7 days physiotherapy (versus 0-2 days) had 8% (5-11%) higher adjusted probability of survival. For patients with dementia, improved probability of survival, discharge home, readmission and indoor mobility recovery were observed with greater physiotherapy access.

Conclusion

Greater access to physiotherapy was associated with a higher probability of positive outcomes. For every 100 patients, greater access could equate to an additional eight patients surviving to 30-days and six avoiding 30-day readmission. The findings suggest a potential benefit in terms of home discharge and outdoor mobility recovery.

KEYWORDS

rehabilitation, physiotherapy, recovery, hip fracture, audit, National Hip Fracture Database

CONTRIBUTION OF THE PAPER

- To substantiate a case for additional physiotherapy, evidence for an association with improved outcomes is needed.
- Analysis of 5,383 patients suggests greater access to physiotherapy was associated with higher probability of positive outcomes.
- For every 100 patients, this could equate to six more patients avoiding 30-day readmission and eight more patients surviving to 30-days.
- The association between access to physiotherapy and survival persisted irrespective of dementia diagnosis.
- For other outcomes, associations varied by the presence/absence of dementia and should be explored by future cohort studies.

INTRODUCTION

Proponents of physiotherapy advocate for increased input early on and throughout the hospital stay after hip fracture surgery to optimise recovery [1]. The National Institute for Health and Care Excellence (NICE) guidelines for physiotherapy in the hospital setting after hip fracture surgery recommend mobilisation on the day of or after surgery, to offer mobilisation at least once a day, and to ensure regular physiotherapy review [2]. Yet, for many settings this is not achieved. For example, a 2017 English and Welsh sprint audit indicated only 20% of patients received physiotherapy on six or seven days, for an average of two or more hours, in the first postoperative week [3, 4]. Fewer than half of patients were prescribed exercise as well as mobilisation [3, 4]. To substantiate a case for additional resource, evidence for an association with improved outcomes is needed.

The current research group previously reported an association between access to postoperative physiotherapy and time to discharge [4]. However, for many patients, this may not be as important as being discharged home (rather than to a care home), surviving, staying at home, and living well [5, 6]. These priorities reflect the World Health Organization's definition of functional ability as 'all the health-related attributes that enable people to be and to do what they have reason to value' [7]. A cohort study (n = 443) in a small group of New York City Hospitals demonstrated promise for an association between access to physiotherapy in the first four days after surgery and mobility at 2-months [8].

This study aimed to examine the association between physiotherapy access in the first seven days after hip fracture surgery and discharge home, readmission, survival, and recovery of mobility, accounting for potential confounders among those with stays of at least one week. Given uncertainty over the optimal physiotherapy management for older adults with dementia after hip fracture surgery [9], this study also sought to determine whether probabilities varied by the presence/absence of a dementia diagnosis.

METHODS

Data source

The National Hip Fracture Database (NHFD) captures care provided to adults aged 60 years or more who are admitted to an acute hospital with hip fracture in England or Wales (national case ascertainment >90%) [10]. In 2017, the UK Chartered Society of Physiotherapy commissioned a sprint audit through the NHFD to capture additional data on the acute physiotherapy management of patients with hip fracture [3]. Pseudo-anonymised data from the physiotherapy sprint audit were linked to the NHFD and hospital and mortality records for 5,383 patients surgically treated for a non-pathological hip fracture in May or June 2017. Details of data cleaning, linkage, selection, and validation are available elsewhere [4].

Exposures

The study exposures included frequency, duration and type of physiotherapy received in the first week after surgery. Frequency was classified both as a one-day increment and as a categorical variable (physiotherapy received on zero to two, three, four, five, or six to seven days out of a possible seven days). Duration was classified both as a 30-minute increment and as a binary variable (<2 hours, ≥2 hours). Type was classified as mobilisation alone [PHFSA code for mobilisation/gait/transfer practice] or mobilisation and exercises [PHFSA code for mobilisation/gait/transfer practice and range of motion/strength/balance]).

Outcomes

The study outcomes included discharge home (among those admitted from home only), survival at 30-days post-admission, readmission within 30-days of discharge, and recovery of ambulatory ability by 120-days post-admission. Recovery was defined as no reduction from pre-fracture ambulatory ability (outdoors or indoors only) [11]. Patients without pre-fracture mobility were excluded from the analysis of recovery.

Potential confounders

Variables with a known association with our study outcomes were adjusted for i.e., age [12], sex [12], prefracture mobility (outdoor, indoor only, no mobility) [for analysis of discharge home, survival and readmission] [12], pre-fracture residence (own home/sheltered housing, nursing care/residential care) [for analysis of recovery] [12], American Society of Anesthesiology (ASA) grade [13], and Hospital Frailty Risk Score (low, intermediate, high risk) [14].

Subgroup

ICD-10 codes were used to identify patients with dementia [ICD-10: E100-E108, E110-E118, E130-E138, E140-E148] during their admission with hip fracture or an admission in the year prior to their hip fracture.

Statistical analysis

Patients with complete data for exposures, outcomes and potential confounders were included in the main analysis. The analysis was limited to those with inpatient stays of at least seven days (and therefore opportunity to experience frequency and duration categorical exposures). Patient and care characteristics were described by median and interquartile ranges (continuous variables) and proportions (categorical variables), overall and by exposure. Mann-Whitney U, χ^2, and Kruskal-Wallis tests were used to compare distributions by exposures. The proportion of patients with each outcome were estimated for each exposure group. Logistic regression models with post-estimation[15] were used to calculate odds ratios (OR) (continuous exposures) or risk differences (RD) (categorical exposures) and their 95% confidence intervals (CI) for discharge home, survival, readmission, and recovery (stratified by pre-fracture ambulatory ability) for patients in receipt of each exposure level, overall and by the presence/absence of a dementia diagnosis. Analyses were completed with R [16].

Multivariable imputation by chained equations was used to determine whether similar findings would be reached following complete case and imputed analyses (Supplementary File 1) [17, 18]. Missing values for the analyses of discharge home or 120-day recovery of ambulatory ability were not imputed as the data were likely not missing at random [17]. To assess the findings' sensitivity to exclusion of those discharged within the first 7-days postoperatively, the analysis was replicated for exposures: 1) a 1-day increase in frequency of physiotherapy; 2) a 30-minute increase in physiotherapy duration; and 3) receipt of mobilisation and exercise compared to mobilisation alone for all patients (Supplementary File 2).

RESULTS

Patient characteristics

Of the 5,383 patients, 73% were female, 82% were admitted from home, and 74% were ambulatory outdoors pre-fracture, 73% presented with an ASA grade ≥III and 40% with a high

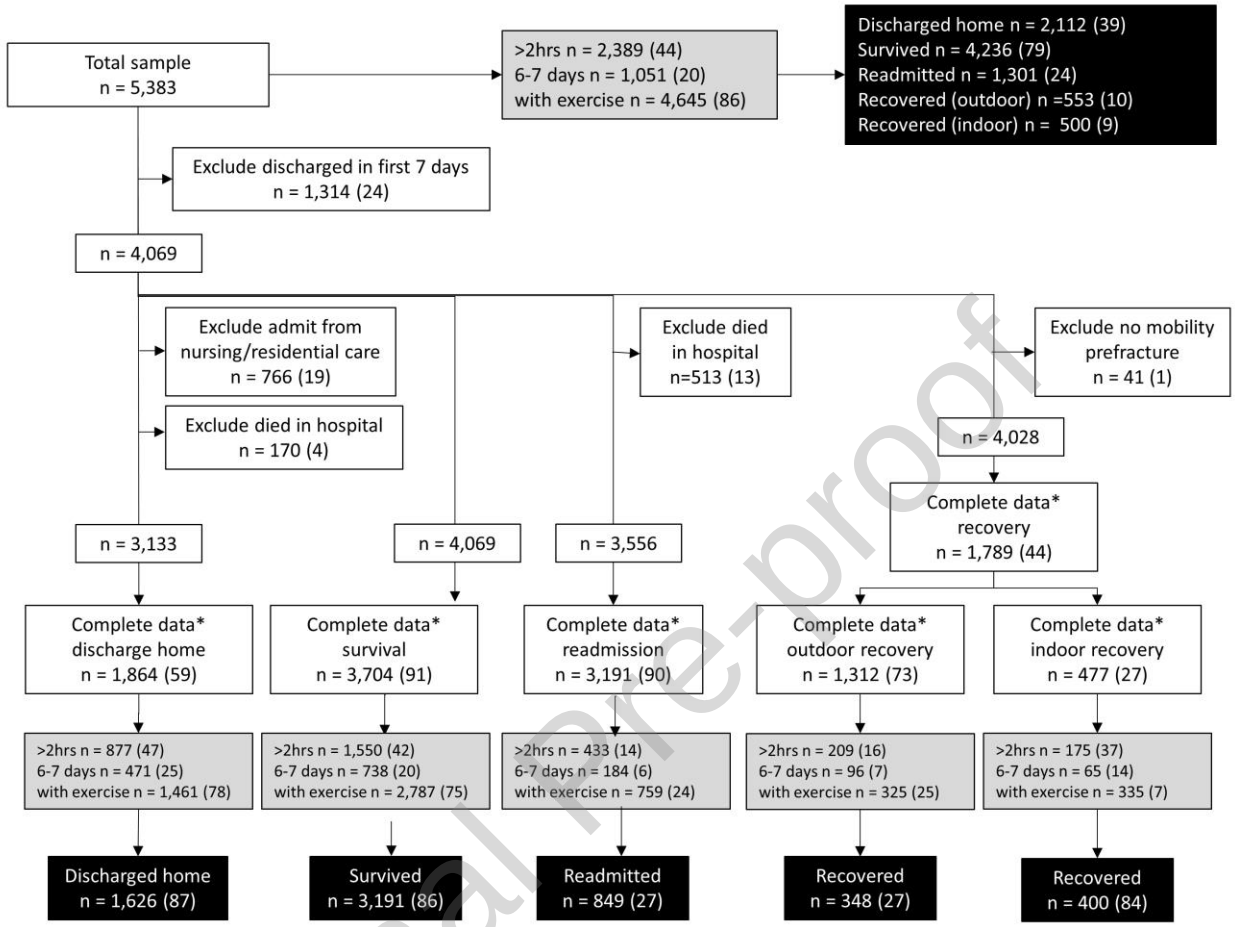
risk of frailty (Table 1, Supplementary File 3 Tables S3_6 – S3_7). Following patient exclusions, 3,704/4,069 (91%) patients had complete data regarding survival, 3,191/3,556 (90%) for readmission, 1,864/3,133 (60%) for discharge home, 1,789/4,028 (44%) for recovery of mobility, (Figure 1). Differences between patients included and excluded from the complete case analysis for each outcome are available in Supplementary File 3 (Tables S3_1 – S3_5).

Table 1. Characteristics of 5,148 patients surgically treated for non-pathological hip fracture overall and by physiotherapy duration

	Total n=5,148†	< 2-hours n=2,759	>/= 2-hours n=2,389
Age, years* (median (IQR))	84 (77 - 89)	84 (77 -90)	84 (78 - 88)
Missing n (%)	1 (0)	1 (0)	0
Length of stay, days* (median (IQR))	12 (7 - 18)	11 (7 - 18)	12 (8 - 18)
Missing, n (%)	299 (6)	149 (5)	150 (6)
Sex, n (%)			
Male	1,386 (27)	742 (27)	644 (27)
Female	3,762 (73)	2,017 (73)	1,745 (73)
Missing	0	0	0
ASA*, n (%)			
I	119 (2)	64 (2)	55 (2)
II	1,270 (25)	599 (22)	671 (29)
III	2,924 (58)	1,596 (59)	1,328 (57)
IV	730 (14)	440 (16)	290 (12)
V	15 (0)	9 (0)	6 (0)
Missing	90 (2)	51 (2)	39 (2)
Hospital Frailty Index*, n (%)			
Low risk	947 (20)	483 (19)	464 (21)
Intermediate risk	1,928 (40)	985 (38)	943 (43)
High risk	1,920 (40)	1,107 (43)	813 (37)
Missing	353 (7)	184 (7)	169 (7)
Prefracture mobility*, n (%)			
Outdoor	3,817 (74)	1,935 (70)	1,882 (79)
Indoor only	1,280 (25)	784 (28)	496 (21)
No mobility	51 (1)	40 (1)	11 (1)
Missing	0	0	0
Prefracture residence*, n (%)			
Own home/sheltered housing	4,202 (82)	2,120 (77)	2,082 (87)
Residential care	585 (11)	385 (14)	200 (8)
Nursing care	358 (7)	251 (9)	107 (5)
Missing	3 (0)	3 (0)	0

IQR = interquartile range; ASA = American Society of Anaesthesiology grade. *p<0.05 †Does not include 235 patients with missing data for duration.

Figure 1: Count and percentage of exposure and outcome for total sample and for each outcome following exclusions.



***after patient exclusions**

Discharge home

Among the 87% (1,626 of 1,864) of patients discharged home, 57% (877 of 1,552; n = 74 with missing data for duration) received ≥2 hours of physiotherapy, 29% (471 of 1,626) received physiotherapy on six or seven days, and 90% (1,461 of 1,619; n = 7 with missing data for type) received mobilisation and exercises. Among the 13% (238 of 1,864) of patients not discharged home, 46% (100 of 219; n = 19 with missing data for duration) received ≥2 hours of physiotherapy, 25% (60 of 238) received physiotherapy on six or seven days, and 83% (196 of 235; n= 3 with missing data for type) received mobilisation and exercises.

Patients in receipt of ≥2 hours physiotherapy (compared to <2 hours), physiotherapy on six to seven days (compared to zero to two days), and mobilisation and exercise (compared to mobilisation alone) had a 5% (95% CI: 2-8%), 8% (95% CI: 3-14%), and 8% (95% CI: 3-14%) higher crude probability of discharge home respectively (Figure 2, Table 2). Following adjustment, the difference in probabilities persisted for ≥2 hours physiotherapy (3% difference, 95% CI: 0-6%) and mobilisation and exercise (6% difference, 95% CI: 1-12%) but not for physiotherapy on six to seven days (compared to zero to two days) (3% difference, 95% CI: -3-8%) (Figure 2, Table 2). The crude and adjusted OR of discharge home following a 30-minute increase in physiotherapy were 1.16 (95% CI: 1.07–1.25) and 1.14 (95% CI: 1.04-1.24) (Table 2). The crude and adjusted OR of discharge home following a 1-day increase in physiotherapy were 1.19 (95% CI: 1.08–1.31) and 1.09 (95% CI: 0.98–1.21) (Table 2).

30-day survival

Among the 86% (3,191 of 3,704) of patients alive at 30-days, 51% (1,550 of 3,051; n = 140 with missing data for duration) received ≥2 hours of physiotherapy, 23% (738 of 3,191) received physiotherapy on six or seven days, and 88% (2,787 of 3,171; n = 20 with missing data for type) received mobilisation and exercises. Among the 14% (513 of 3,704) of patients not alive at 30-days, 39% (189 of 484; n = 29 with missing data for duration) received ≥2 hours of

physiotherapy, 16% (82 of 513) received physiotherapy on six or seven days, and 82% (412 of 500; n = 13 with missing data for type) received mobilisation and exercises.

Patients in receipt of physiotherapy on six to seven days (compared to zero to two days), ≥2 hours physiotherapy (compared to <2 hours), and mobilisation and exercise (compared with mobilisation alone) had a 12% (95% CI: 9-16%), 6% (95% CI: 3-8%), and 6% (95% CI: 2-9%) higher crude probability of 30-day survival, respectively (Figure 2, Table 2). Following adjustment, the difference in probabilities persisted for physiotherapy on six to seven days (compared to zero to two days) (8% difference, 95% CI: 5-11%), ≥2 hours physiotherapy (4% difference, 95% CI: 2-6%) and mobilisation and exercise (3% difference, 95% CI: 0-7%) (Figure 2, Table 2). The crude and adjusted OR of 30-day survival following a 30-minute increase in physiotherapy were 1.17 (95% CI: 1.11–1.24) and 1.12 (95% CI: 1.06-1.18) (Table 2). The crude and adjusted OR of 30-day survival following a 1-day increase in physiotherapy were 1.27 (95% CI: 1.19–1.35) and 1.19 (95% CI: 1.11-1.27) (Table 2).

30-day readmission

Among the 27% (849 of 3,191) of patients readmitted within 30-days, 53% (433 of 811; n = 38 with missing data for duration) received ≥2 hours of physiotherapy, 22% (184 of 849) received physiotherapy on six or seven days, and 90% (759 of 846; n = 3 with missing data for type) received mobilisation and exercises. Among the 73% (2,342 of 3,191) of patients not readmitted within 30-days, 50% (1,117 of 2,240; n = 102 with missing data for duration) received ≥2 hours of physiotherapy, 24% (554 of 2,342) received physiotherapy on six or seven days, and 87% (2,028 of 2,325; n = 17 with missing data for type) received mobilisation and exercises.

Patients in receipt of mobilisation and exercise (compared with mobilisation alone) and ≥2 hours physiotherapy (compared to <2 hours) had a 5% (95% CI: 0-9%) and 3% (95% CI: 0-6%) lower crude probability of 30-day readmission, respectively (Figure 2, Table 2). Following adjustment, the difference in probabilities persisted for ≥2 hours physiotherapy (3% difference, 95% CI: 0-

6%) and mobilisation and exercise (6% difference, 95% CI: 2-10%) (Figure 2, Table 2). The crude and adjusted OR of 30-day readmission following a 30-minute increase in physiotherapy were 1.03 (95% CI: 0.99-1.07) and 1.04 (95% CI: 1.00-1.08) (Table 2). The crude and adjusted OR of 30-day readmission following a 1-day increase in physiotherapy were 1.02 (95% CI: 0.96-1.08) and 1.06 (95% CI: 1.00-1.12) (Table 2).

120-day recovery of outdoor mobility

Among the 27% (348 of 1,312) of patients who recovered outdoor mobility, 62% (209 of 336; n = 12 with missing data for duration) received ≥2 hours of physiotherapy, 28% (96 of 348) received physiotherapy on six or seven days, and 94% (325 of 346; n = 2 with missing data for type) received mobilisation and exercises. Among the 73% (946 of 1,312) of patients who did not recover outdoor mobility, 53% (481 of 908; n = 56 with missing data for duration) received ≥2 hours of physiotherapy, 24% (229 of 964) received physiotherapy on six or seven days, and 90% (863 of 960; n = 4 with missing data for type) received mobilisation and exercises.

Patients in receipt of ≥2 hours physiotherapy (compared to <2 hours), physiotherapy on six to seven days (compared to zero to two days), and mobilisation and exercise (compared to mobilisation alone) had a 7% (95% CI: 2-12%), 8% (95% CI: 1-15%), and 10% (95% CI: 2-17%) higher crude probability of recovering outdoor mobility respectively (Figure 2, Table 2). Following adjustment, the difference in probabilities persisted for ≥2 hours physiotherapy (6% difference, 95% CI: 1-11%) and mobilisation and exercise (11% difference, 95% CI: 3-18%) but not for physiotherapy on six to seven days (compared to zero to two days) (7% difference, 95% CI: -1-15%) (Figure 2, Table 2). The crude and adjusted OR of recovering outdoor mobility following a 30-minute increase in physiotherapy were 1.08 (95% CI: 1.01-1.16) and 1.08 (95% CI: 1.01-1.16) (Table 2). The crude and adjusted OR of recovering outdoor mobility following a 1-day increase in physiotherapy were 1.09 (95% CI: 1.00–1.20) and 1.08 (95% CI: 0.98-1.19) respectively (Table 2).

120-day recovery of indoor mobility

Among the 84% (400 of 477) of patients who recovered indoor mobility, 46% (175 of 381; n = 19 with missing data for duration) received ≥2 hours of physiotherapy, 16% (65 of 400) received physiotherapy on six or seven days, and 84% (335 of 399; n = 1 with missing data for type) received mobilisation and exercises. Among the 16% (77 of 477) of patients who did not recover indoor mobility, 34% (24 of 71; n = 6 with missing data for duration) received ≥2 hours of physiotherapy, 13% (10 of 77) received physiotherapy on six or seven days, and 77% (58 of 75; n = 2 with missing data for type) received mobilisation and exercises.

Patients in receipt of physiotherapy on six to seven days (compared to zero to two days) and ≥2 hours physiotherapy (compared to <2 hours) had a 13% (95% CI: 2-24%) and 7% (95% CI: 0-13%) higher crude probability of recovering indoor mobility (Figure 2, Table 2). There were no differences in the crude probability of recovering indoor mobility for exercise over mobilisation alone, or in adjusted probabilities for an increase in the frequency or duration of physiotherapy (Figure 2, Table 2). The crude and adjusted OR of recovering indoor mobility following a 30-minute increase in physiotherapy were 1.25 (95% CI: 1.07-1.49) and 1.22 (95% CI: 1.03-1.47) (Table 2). The crude and adjusted OR of recovering outdoor mobility following a 1-day increase in physiotherapy were 1.29 (95% CI: 1.08–1.56) and 1.24 (95% CI: 1.03-1.51) respectively (Table 2).

Table 2: The association between duration, frequency, and type of rehabilitation and discharge home, readmission and survival at 30-days post-discharge, and recovery of mobility at 120-days.

Exposure	Patients with outcome n (%)	Unadjusted (95% CI)	Adjusted (95% CI) *
Discharge home (n = 1864)			
Duration (n = 1771, missing n= 93) †			
≥ 2 hours physiotherapy received	877/977 (89)	RD: 0.05 (0.02 , 0.08)	RD: 0.03 (0.00 , 0.06)
< 2 hours physiotherapy received	675/794 (85)	-	-
30-minute increase in physiotherapy	1771 (100)	OR: 1.16 (1.07 , 1.25)	OR: 1.14 (1.04 , 1.24)
Frequency (n = 1864, missing n = 0) †			
physiotherapy received on 6-7 days	471/531 (89)	RD: 0.08 (0.03 , 0.14)	RD: 0.03 (-0.03 , 0.08)
physiotherapy received on 5 days	368/424 (87)	RD: 0.06 (0.02 , 0.11)	RD: 0.02 (-0.02 , 0.06)
physiotherapy received on 4 days	445/486 (92)	RD: 0.05 (0.02 , 0.08)	RD: 0.01 (-0.01 , 0.05)
physiotherapy received on 3 days	225/268 (84)	RD: 0.02 (0.01 , 0.05)	RD: 0.01 (-0.01 , 0.02)
physiotherapy received on 0-2 days	117/155 (75)	-	-
1 day increase in physiotherapy	1846 (100)	OR: 1.19 (1.08 , 1.31)	OR: 1.09 (0.98 , 1.21)
Type (n = 1854, missing n = 10) †			
mobilisation and exercises	1461/1657 (88)	RD: 0.08 (0.03 , 0.14)	RD: 0.06 (0.01 , 0.12)
mobilisation only	158/197 (80)	-	-
Survival at 30-days (n = 3704)			
Duration (n = 3535, missing n = 169) †			
≥ 2 hours physiotherapy received	1550/1739 (89)	RD: 0.06 (0.03 , 0.08)	RD: 0.04 (0.02 , 0.06)
< 2 hours physiotherapy received	1501/1796 (84)	-	-
30-minute increase in physiotherapy	3535 (100)	OR: 1.17 (1.11 , 1.24)	OR: 1.12 (1.06 , 1.18)
Frequency (n = 3704, missing n = 0) †			
physiotherapy received on 6-7 days	738/820 (90)	RD: 0.12 (0.09 , 0.16)	RD: 0.08 (0.05 , 0.11)
physiotherapy received on 5 days	712/807 (88)	RD: 0.10 (0.07 , 0.13)	RD: 0.06 (0.03 , 0.09)
physiotherapy received on 4 days	826/941 (88)	RD: 0.07 (0.05 , 0.10)	RD: 0.04 (0.02 , 0.06)
physiotherapy received on 3 days	543/641 (85)	RD: 0.04 (0.03 , 0.06)	RD: 0.02 (0.01 , 0.04)
physiotherapy received on 0-2 days	372/495 (75)	-	-
1 day increase in physiotherapy	3704 (100)	OR: 1.27 (1.19 , 1.35)	OR: 1.19 (1.11 , 1.27)
Type (n = 3671, missing n = 33) †			
mobilisation and exercises	2787/3199 (87)	RD: 0.06 (0.02 , 0.09)	RD: 0.03 (0.00 , 0.07)
mobilisation only	384/472 (81)	-	-
Readmission by 30-days (n = 3191)			
Duration (n = 3051, missing n = 140) †			
≥ 2 hours physiotherapy received	433/1550 (28)	RD: 0.03 (0.00 , 0.06)	RD: 0.03 (0.00 , 0.06)
< 2 hours physiotherapy received	378/1501 (25)	-	-
30-minute increase in physiotherapy	3051 (100)	OR: 1.03 (0.99 , 1.07)	OR: 1.04 (1.00 , 1.08)
Frequency (n = 3191, missing n = 0) †			
physiotherapy received on 6-7 days	184/738 (25)	RD: 0.01 (-0.04 , 0.06)	RD: 0.04 (-0.01 , 0.08)
physiotherapy received on 5 days	202/712 (28)	RD: 0.01 (-0.03 , 0.04)	RD: 0.03 (0.00 , 0.06)
physiotherapy received on 4 days	228/826 (28)	RD: 0.00 (-0.02 , 0.03)	RD: 0.02 (-0.01 , 0.04)
physiotherapy received on 3 days	151/543 (28)	RD: 0.00 (-0.01 , 0.01)	RD: 0.01 (0.00 , 0.02)
physiotherapy received on 0-2 days	84/372 (23)	-	-
1 day increase in physiotherapy	3191 (100)	OR: 1.02 (0.96 , 1.08)	OR: 1.06 (1.00 , 1.12)
Type (n = 3171, missing n = 20) †			
mobilisation and exercises	759/2787 (27)	RD: 0.05 (0.00 , 0.09)	RD: 0.06 (0.02 , 0.10)
mobilisation only	87/384 (23)	-	-
Recovery at 120-days, outdoor ambulation prefracture (n = 1312)			
Duration (n = 1244, missing n = 68) †			
≥ 2 hours physiotherapy received	209/690 (30)	RD: 0.07 (0.02 , 0.12)	RD: 0.06 (0.01 , 0.11)
< 2 hours physiotherapy received	127/554 (23)	-	-
30-minute increase in physiotherapy	1244 (100)	OR: 1.08 (1.01 , 1.16)	OR: 1.08 (1.01 , 1.16)
Frequency (n = 1312, missing n = 0) †			
physiotherapy received on 6-7 days	96/325 (30)	RD: 0.08 (0.01 , 0.15)	RD: 0.07 (-0.01 , 0.15)
physiotherapy received on 5 days	79/287 (28)	RD: 0.06 (0.01 , 0.11)	RD: 0.05 (0.00 , 0.10)

physiotherapy received on 4 days	94/349 (27)	RD: 0.04 (0.00 , 0.07)	RD: 0.03 (0.00 , 0.07)
physiotherapy received on 3 days	53/226 (23)	RD: 0.02 (0.00 , 0.03)	RD: 0.02 (0.00 , 0.03)
physiotherapy received on 0-2 days	26/123 (21)	-	-
1 day increase in physiotherapy	1312 (100)	OR: 1.09 (1.00 , 1.20)	OR: 1.08 (0.98 , 1.19)
Type (n = 1306, missing n = 6) †			
mobilisation and exercises	325/1188 (27)	RD: 0.1 (0.02 , 0.17)	RD: 0.11 (0.03 , 0.18)
mobilisation only	21/118 (18)	-	-
Recovery at 120-days, indoor ambulation prefracture (n = 477)			
Duration (n = 452, missing n = 25) †			
≥ 2 hours physiotherapy received	175/199 (88)	RD: 0.07 (0.00 , 0.13)	RD: 0.06 (-0.01 , 0.13)
< 2 hours physiotherapy received	206/253 (81)	-	-
30-minute increase in physiotherapy	452 (100)	OR: 1.25 (1.07 , 1.49)	OR: 1.22 (1.03 , 1.47)
Frequency (n = 477, missing n = 0) †			
physiotherapy received on 6-7 days	65/75 (87)	RD: 0.13 (0.02 , 0.24)	RD: 0.10 (0.00 , 0.22)
physiotherapy received on 5 days	76/88 (86)	RD: 0.10 (0.02 , 0.21)	RD: 0.08 (-0.01 , 0.17)
physiotherapy received on 4 days	121/138 (88)	RD: 0.08 (0.01 , 0.15)	RD: 0.06 (-0.01 , 0.13)
physiotherapy received on 3 days	86/103 (84)	RD: 0.04 (0.01 , 0.09)	RD: 0.03 (0.00 , 0.07)
physiotherapy received on 0-2 days	52/73 (71)	-	-
1 day increase in physiotherapy	477 (100)	OR: 1.29 (1.08 , 1.56)	OR: 1.24 (1.03 , 1.51)
Type (n = 474, missing n = 3) †			
mobilisation and exercises	335/393 (85)	RD: 0.06 (-0.04 , 0.16)	RD: 0.04 (-0.05 , 0.13)
mobilisation only	64/81 (79)	-	-

CI = confidence interval, RD = risk difference; OR = odds ratio

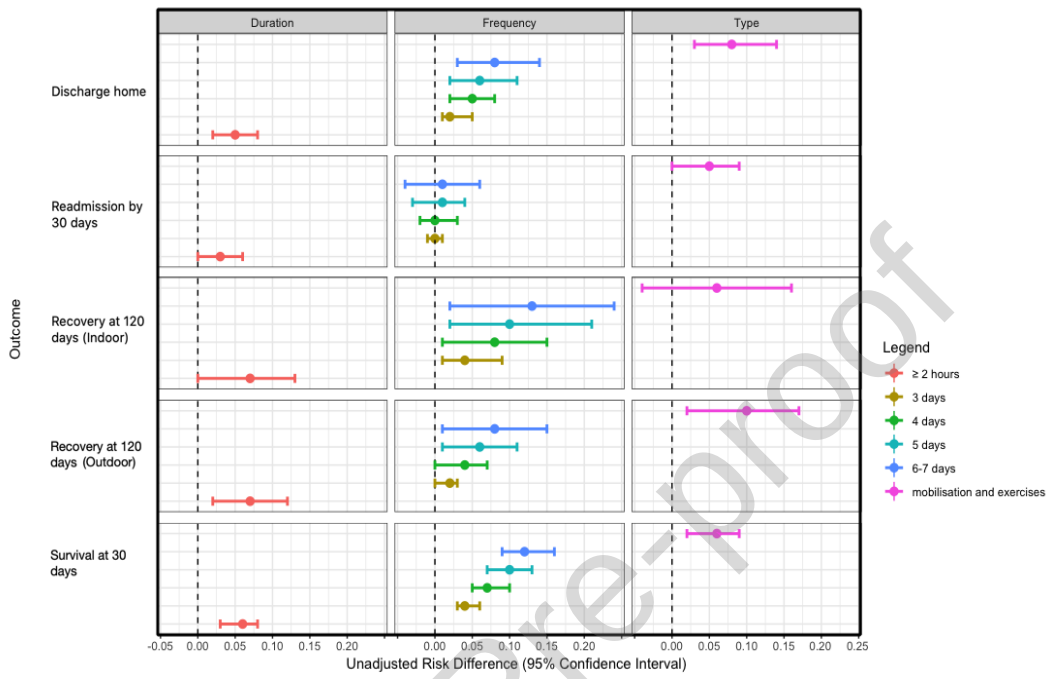
*with adjustment for confounders variables: age, sex, ASA grade, Hospital Frailty risk score, prefracture residence (only for 120day recovery), mobility prior to hip fracture (not for 120day recovery).

180, 194, and 192 cases with missing data of at least one of these confounder variables were excluded from the duration, frequency, and type analyses respectively for discharge home. 60, 66, and 66 cases with missing data of at least one of these confounder variables were excluded from the duration, frequency, and type analyses respectively for survival at 30-days. 54, 60, and 60 cases with missing data of at least one of these confounder variables were excluded from the duration, frequency, and type analyses respectively for readmission by 30-days. 103, 110, and 107 cases with missing data of at least one of these confounder variables were excluded from the duration, frequency, and type analyses respectively for recovery by 120 days among those with outdoor ambulation prefracture. 21, 25, and 25 cases with missing data of at least one of these confounder variables were excluded from the duration, frequency, and type analyses respectively for recovery by 120 days among those with indoor ambulation only prefracture.

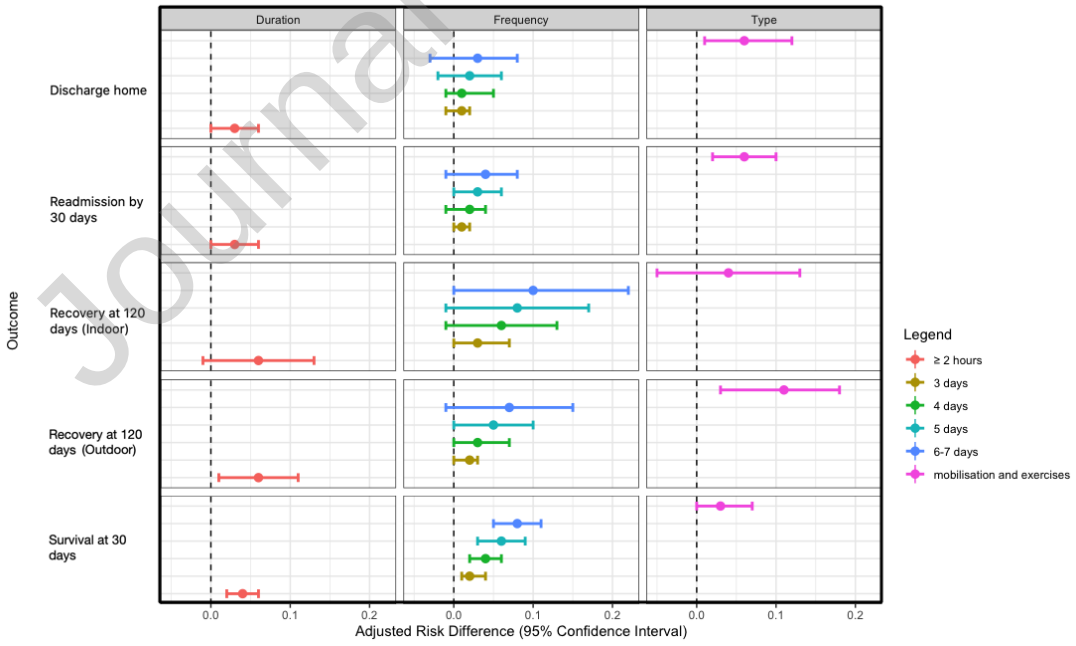
†Reference for duration = <2hours, frequency = 0-2 days, type = mobilisation alone.

Figure 2: Difference in the probability of discharge home, readmission by 30-days, recovery at 120 days, and survival at 30-days by duration, frequency, and type of physiotherapy before (a) and after (b) adjustment for potential confounders.

(a)



(b)



Analyses by dementia diagnosis

Among 1,340 patients with dementia, 42% (560 of 1,340) received ≥2 hours of physiotherapy, 17% (228 of 1,340) received physiotherapy on six or seven days, and 80% (1,067 of 1,340) received mobilisation and exercises. Among 2,364 patients without dementia, 50% (1,179 of 2,364) received ≥2 hours of physiotherapy, 25% (592 of 2,364) received physiotherapy on six or seven days, and 90% (2,132 of 2,364) received mobilisation and exercises. Similar probabilities of survival were noted for those with and without dementia (Table 3). Physiotherapy of ≥2 hours (vs. <2 hours), on six or seven days (compared to zero to two days), and mobilisation and exercises (compared to mobilisation alone) were associated with higher probabilities of discharge home and readmission for patients with dementia, but not for patients without dementia (Table 3). Physiotherapy of ≥2 hours (vs. <2 hours) was associated with a higher probability of recovering outdoor mobility for those without dementia, and of recovering indoor mobility for those with dementia (Table 3).

Sensitivity and missing data analyses

Similar findings were noted for survival and readmission for overall complete case and imputed analyses (Supplementary File 1). The associations for analyses by dementia were more conservative for imputed when compared to complete case. Similar results were observed for analysis of patients with hospital stays of at least seven days and analysis which included those stays shorter than seven days (Supplementary File 2) despite differences in group characteristics (Supplementary File 3).

Table 3: The association between duration, frequency, and type of rehabilitation and readmission and survival at 30-days post-discharge, and recovery of mobility at 120-days by diagnosis of dementia.

	Diagnosis of dementia			No diagnosis of dementia		
Exposure	Patients n (%)	Unadjusted (95% CI)	Adjusted (95% CI)	Patients n (%)	Unadjusted (95% CI)	Adjusted (95% CI)

Discharge home						
Duration †						
≥ 2 hours physiotherapy received	147/186 (79)	RD: 0.09 (0.00 , 0.17)	RD: 0.09 (0.00 , 0.17)	646/700 (92)	RD: 0.02 (-0.01 , 0.05)	RD: 0.01 (-0.02 , 0.04)
< 2 hours physiotherapy received	134/190 (71)	-	-	489/542 (90)	-	-
30-minute increase in physiotherapy	376/397 (95)	OR: 1.14 (1.02 , 1.29)	OR: 1.13 (1.00 , 1.29)	1242/1303 (95)	OR: 1.17 (1.04 , 1.32)	OR: 1.14 (1.01 , 1.29)
Frequency †						
physiotherapy received on 6-7 days	72/90 (80)	RD: 0.19 (0.06 , 0.33)	RD: 0.16 (0.02 , 0.29)	345/382 (90)	RD: -0.01 (-0.05 , 0.05)	RD: -0.02 (-0.07 , 0.03)
physiotherapy received on 5 days	72/92 (78)	RD: 0.15 (0.05 , 0.27)	RD: 0.13 (0.02 , 0.24)	267/301 (89)	RD: 0.00 (-0.04 , 0.04)	RD: -0.02 (-0.05 , 0.03)
physiotherapy received on 4 days	68/90 (76)	RD: 0.11 (0.03 , 0.19)	RD: 0.09 (0.01 , 0.17)	339/354 (96)	RD: 0.00 (-0.02 , 0.03)	RD: -0.01 (-0.03 , 0.02)
physiotherapy received on 3 days	54/76 (71)	RD: 0.06 (0.02 , 0.11)	RD: 0.05 (0.00 , 0.09)	154/169 (91)	RD: 0.00 (-0.01 , 0.02)	RD: -0.01 (-0.01 , 0.01)
physiotherapy received on 0-2 days	28/49 (57)	-	-	83/97 (86)	-	-
1 day increase in physiotherapy	397 (100)	OR: 1.29 (1.1 , 1.51)	OR: 1.27 (1.07 , 1.5)	1303 (100)	OR: 1.01 (0.88 , 1.16)	OR: 0.96 (0.82 , 1.11)
Type †						
mobilisation and exercises	255/334 (76)	RD: 0.12 (0.00 , 0.24)	RD: 0.14 (0.01 , 0.27)	1080/1181 (91)	RD: 0.03 (-0.03 , 0.08)	RD: 0.02 (-0.03 , 0.09)
mobilisation only	39/61 (64)	-	-	103/116 (89)	-	-
Survival at 30-days						
Duration †						
≥ 2 hours physiotherapy received	467/560 (83)	RD: 0.06 (0.02 , 0.11)	RD: 0.06 (0.01 , 0.1)	1083/1179 (92)	RD: 0.04 (0.01 , 0.06)	RD: 0.03 (0.00 , 0.05)
< 2 hours physiotherapy received	553/717 (77)	-	-	948/1079 (88)	-	-
30-minute increase in physiotherapy	1277/1340 (95)	OR: 1.12 (1.05 , 1.21)	OR: 1.11 (1.03 , 1.19)	2258/2364 (96)	OR: 1.17 (1.08 , 1.28)	OR: 1.12 (1.03 , 1.23)
Frequency †						
physiotherapy received on 6-7 days	188/228(83)	RD: 0.10 (0.04 , 0.16)	RD: 0.08 (0.01 , 0.14)	550/592 (93)	RD: 0.11 (0.06 , 0.15)	RD: 0.08 (0.04 , 0.12)
physiotherapy received on 5 days	224/267 (84)	RD: 0.08 (0.03 , 0.14)	RD: 0.06 (0.01 , 0.12)	488/540 (90)	RD: 0.09 (0.05 , 0.13)	RD: 0.06 (0.03 , 0.10)
physiotherapy received on 4 days	265/332 (80)	RD: 0.05 (0.02 , 0.10)	RD: 0.04 (0.01 , 0.08)	561/609 (92)	RD: 0.07 (0.04 , 0.10)	RD: 0.04 (0.02 , 0.07)
physiotherapy received on 3 days	211/268 (79)	RD: 0.03 (0.01 , 0.05)	RD: 0.02 (0.00 , 0.04)	332/373 (89)	RD: 0.04 (0.02 , 0.06)	RD: 0.02 (0.01 , 0.04)
physiotherapy received on 0-2 days	178/245 (73)	-	-	194/250 (78)	-	-
1 day increase in physiotherapy	1340 (100)	OR: 1.17 (1.07 , 1.28)	OR: 1.14 (1.04 , 1.25)	2364 (100)	OR: 1.29 (1.18 , 1.42)	OR: 1.23 (1.12 , 1.36)
Type †						
mobilisation and exercises	863/1067 (81)	RD: 0.05 (-0.02 , 0.1)	RD: 0.04 (-0.01 , 0.1)	1924/2132 (90)	RD: 0.03 (-0.01 , 0.08)	RD: 0.02 (-0.02 , 0.07)
mobilisation only	193/253	-	-	191/219	-	-

	(76)			(87)		
Readmission by 30-days						
Duration †						
≥ 2 hours physiotherapy received	142/467 (30)	RD: 0.06 (0.00 , 0.12)	RD: 0.05 (0.00 , 0.11)	291/1083 (27)	RD: 0.01 (-0.03 , 0.05)	RD: 0.01 (-0.02 , 0.05)
< 2 hours physiotherapy received	135/553 (24)	-	-	243/948 (26)	-	-
30-minute increase in physiotherapy	1020/1066 (96)	OR: 1.05 (0.98 , 1.11)	OR: 1.04 (0.98 , 1.11)	2031/2125 (96)	OR: 1.02 (0.97 , 1.08)	OR: 1.03 (0.97 , 1.09)
Frequency †						
physiotherapy received on 6-7 days	54/188 (29)	RD: 0.11 (0.03 , 0.18)	RD: 0.10 (0.03 , 0.19)	130/550 (24)	RD: -0.04 (-0.10 , 0.02)	RD: -0.02 (-0.08 , 0.04)
physiotherapy received on 5 days	70/224 (31)	RD: 0.08 (0.02 , 0.13)	RD: 0.08 (0.02 , 0.13)	132/488 (27)	RD: -0.03 (-0.08 , 0.01)	RD: -0.01 (-0.05 , 0.03)
physiotherapy received on 4 days	86/265 (33)	RD: 0.05 (0.01 , 0.08)	RD: 0.05 (0.01 , 0.08)	142/561 (25)	RD: -0.02 (-0.05 , 0.01)	RD: -0.01 (-0.04 , 0.02)
physiotherapy received on 3 days	47/211 (22)	RD: 0.02 (0.01 , 0.04)	RD: 0.02 (0.01 , 0.04)	104/332 (31)	RD: -0.01 (-0.03 , 0.00)	RD: 0.00 (-0.02 , 0.01)
physiotherapy received on 0-2 days	36/178 (20)	-	-	48/194 (25)	-	-
1 day increase in physiotherapy	1066 (100)	OR: 1.14 (1.04 , 1.25)	OR: 1.14 (1.04 , 1.26)	2125 (100)	OR: 0.96 (0.89 , 1.03)	OR: 0.99 (0.92 , 1.06)
Type †						
mobilisation and exercises	250/863 (29)	RD: 0.07 (0.00 , 0.14)	RD: 0.06 (0.00 , 0.13)	509/1924 (27)	RD: 0.03 (-0.03 , 0.1)	RD: 0.04 (-0.03 , 0.09)
mobilisation only	43/193 (22)	-	-	44/191 (23)	-	-
Recovery at 120-days, outdoor ambulation prefracture						
Duration †						
≥ 2 hours physiotherapy received	34/134 (25)	RD: 0.04 (-0.06 , 0.15)	RD: 0.05 (-0.05 , 0.16)	157/508 (31)	RD: 0.07 (0.02 , 0.13)	RD: 0.07 (0.01 , 0.13)
< 2 hours physiotherapy received	30/143 (21)	-	-	89/376 (24)	-	-
30-minute increase in physiotherapy	277/289 (96)	OR: 1.08 (0.94 , 1.23)	OR: 1.11 (0.96 , 1.29)	884/934 (95)	OR: 1.09 (1.00 , 1.18)	OR: 1.08 (1.00 , 1.18)
Frequency †						
physiotherapy received on 6-7 days	15/54 (28)	RD: 0.09 (-0.04 , 0.24)	RD: 0.11 (-0.02 , 0.26)	72/241 (30)	RD: 0.07 (-0.03 , 0.16)	RD: 0.06 (-0.03 , 0.15)
physiotherapy received on 5 days	14/62 (23)	RD: 0.07 (-0.03 , 0.16)	RD: 0.08 (-0.03 , 0.18)	61/211 (29)	RD: 0.05 (-0.01 , 0.11)	RD: 0.05 (-0.02 , 0.11)
physiotherapy received on 4 days	17/69 (25)	RD: 0.04 (-0.03 , 0.09)	RD: 0.05 (-0.01 , 0.10)	69/258 (27)	RD: 0.03 (-0.01 , 0.07)	RD: 0.03 (-0.02 , 0.07)
physiotherapy received on 3 days	11/59 (19)	RD: 0.02 (-0.01 , 0.04)	RD: 0.02 (-0.01 , 0.05)	38/153 (25)	RD: 0.02 (0.00 , 0.03)	RD: 0.01 (-0.01 , 0.03)
physiotherapy received on 0-2 days	8/45 (18)	-	-	16/71 (23)	-	-
1 day increase in physiotherapy	289 (100)	OR: 1.11 (0.91 , 1.35)	OR: 1.14 (0.93 , 1.41)	934 (100)	OR: 1.09 (0.97 , 1.22)	OR: 1.07 (0.96 , 1.21)
Type †						
mobilisation and exercises	58/250 (23)	RD: 0.05 (-0.08 , 0.18)	RD: 0.08 (-0.03 , 0.2)	245/863 (28)	RD: 0.14 (0.05 , 0.22)	RD: 0.13 (0.04 , 0.22)

mobilisation only	7/39 (18)	-	-	10/68 (15)	-	-
Recovery at 120-days, indoor ambulation prefracture						
Duration †						
≥ 2 hours physiotherapy received	91/105 (87)	RD: 0.13 (0.04 , 0.22)	RD: 0.12 (0.01 , 0.22)	77/85 (91)	RD: 0.00 (-0.08 , 0.09)	RD: -0.01 (-0.1 , 0.08)
< 2 hours physiotherapy received	98/133 (74)	-	-	100/111 (90)	-	-
30-minute increase in physiotherapy	238/251 (95)	OR: 1.28 (1.07 , 1.58)	OR: 1.26 (1.04 , 1.57)	196/205 (96)	OR: 1.16 (0.85 , 1.65)	OR: 1.12 (0.79 , 1.62)
Frequency †						
physiotherapy received on 6-7 days	27/32 (84)	RD: 0.16 (0.00 , 0.32)	RD: 0.13 (-0.03 , 0.29)	34/38 (90)	RD: 0.09 (-0.05 , 0.26)	RD: 0.07 (-0.09 , 0.22)
physiotherapy received on 5 days	42/51 (82)	RD: 0.13 (0.00 , 0.27)	RD: 0.11 (-0.02 , 0.25)	32/35 (91)	RD: 0.08 (-0.04 , 0.23)	RD: 0.06 (-0.05 , 0.22)
physiotherapy received on 4 days	56/69 (81)	RD: 0.09 (0.00 , 0.21)	RD: 0.07 (-0.02 , 0.20)	60/61 (98)	RD: 0.06 (-0.02 , 0.20)	RD: 0.04 (-0.04 , 0.18)
physiotherapy received on 3 days	44/57 (77)	RD: 0.05 (0.00 , 0.11)	RD: 0.04 (-0.01 , 0.11)	37/41 (90)	RD: 0.03 (-0.01 , 0.11)	RD: 0.02 (-0.02 , 0.12)
physiotherapy received on 0-2 days	28/42 (67)	-	-	23/30 (77)	-	-
1 day increase in physiotherapy	251 (100)	OR: 1.31 (1.05 , 1.64)	OR: 1.26 (1.00 , 1.60)	205 (100)	OR: 1.31 (0.92 , 1.87)	OR: 1.25 (0.88 , 1.80)
Type †						
mobilisation and exercises	157/195 (81)	RD: 0.06 (-0.06 , 0.2)	RD: 0.05 (-0.07 , 0.18)	169/186 (91)	RD: 0.02 (-0.11 , 0.19)	RD: 0.00 (-0.11 , 0.14)
mobilisation only	40/54 (74)	-	-	16/18 (89)	-	-

CI = confidence interval, RD = risk difference; OR = odds ratio

*with adjustment for confounders variables: age, sex, ASA grade, Hospital Frailty risk score, prefracture residence (only for 120day recovery), mobility prior to hip fracture (not for 120day recovery).

For patients with dementia: 6, 7, and 7 cases with missing data of at least one of these confounder variables were excluded from the duration, frequency, and type analyses respectively for discharge home. 19, 21, and 21 cases with missing data of at least one of these confounder variables were excluded from the duration, frequency, and type analyses respectively for survival at 30-days. 18, 20, and 20 cases with missing data of at least one of these confounder variables were excluded from the duration, frequency, and type analyses respectively for readmission by 30-days. 4, 4, and 4 cases with missing data of at least one of these confounder variables were excluded from the duration, frequency, and type analyses respectively for recovery by 120 days among those with outdoor ambulation prefracture. 2, 2, and 2 cases with missing data of at least one of these confounder variables were excluded from the duration, frequency, and type analyses respectively for recovery by 120 days among those with indoor ambulation only prefracture. For patients without dementia:21, 23, and 23 cases with missing data of at least one of these confounder variables were excluded from the duration, frequency, and type analyses respectively for discharge home. 41, 45, and 45 cases with missing data of at least one of these confounder variables were excluded from the duration, frequency, and type analyses respectively for survival at 30-days. 36, 40, and 40 cases with missing data of at least one of these confounder variables were excluded from the duration, frequency, and type analyses respectively for readmission by 30-days. 16, 17, and 17 cases with missing data of at least one of these confounder variables were excluded from the duration, frequency, and type analyses respectively for recovery by 120 days among those with outdoor ambulation prefracture. 1, 2, and 2 cases with missing data of at least one of these confounder variables were excluded from the duration, frequency, and type analyses respectively for recovery by 120 days among those with indoor ambulation only prefracture.

†Reference for duration = <2hours, frequency = 0-2 days, type = mobilisation alone.

DISCUSSION

Main findings

Longer duration and more comprehensive type of physiotherapy were associated with a higher probability of discharge home, 30-day survival, and recovery of outdoor mobility, and a lower

probability of 30-day readmission. There was inconsistent evidence for an association between access to physiotherapy and recovery among those only able to mobilise indoors pre-fracture. The probabilities of discharge home, readmission, and recovery of indoor mobility by access to physiotherapy varied by the presence/absence of dementia with associations only observed for those with the condition. For recovery of outdoor mobility, an association was observed only for those without dementia.

For every 100 patients, increasing provision of physiotherapy to at least two hours in the first postoperative week would potentially equate to an additional three patients being discharged home, four surviving to 30-days, three avoiding 30-day readmission, and six recovering outdoor mobility each year. The inclusion of exercise to physiotherapy management for all patients would potentially equate to an additional six being discharged home, three surviving to 30-days, six avoiding 30-day readmission, and 11 recovering outdoor mobility. Physiotherapy on six to seven days in the first postoperative week for all patients would potentially equate to an additional eight patients surviving to 30-days.

Interpretation

Our previous paper reported an association between access to physiotherapy and length of stay [4]. Here we add the increased likelihood of patients being discharge to their own home when physiotherapy was of longer duration and included exercise (vs. mobilisation alone). Previous qualitative evidence highlighted discharge home as a perceived valued indicator of 'recovery' among patients in the early postoperative phase after hip fracture [19]. Moreover, access to physiotherapy was associated with staying alive and at home. The observed association may relate to the role of physiotherapy in preserving independence. This proposed mechanism is supported by evidence which suggests patients who do not regain basic mobility had a 26% higher risk of readmission after hip fracture [20].

A recent systematic review of the perspectives of 279 adults aged 60 years or more with hip fracture, indicated that they only considered themselves 'recovered' from hip fracture when they become independent in activities considered to be meaningful to them, often encapsulated around ambulatory abilities [6]. Our study reports an association between longer duration (minutes) physiotherapy and that which incorporated exercise (vs. mobilisation alone) and recovery of outdoor mobility by 120-days. The association between physiotherapy and recovery was uncertain when assessed specifically for people who were unable to walk outside pre-fracture. This may relate to the low event rates observed, a lack of granularity in the definition of 'indoor mobility' or could suggest access to physiotherapy is insufficient to support patients to achieve what matters most to them.

For the current study the subgroup analysis by dementia diagnosis was underpowered and should be considered as hypothesis generating. In total, 8-10% fewer patients with dementia received physiotherapy for at least two hours, on six or seven days, and which included exercise than patients without dementia. This was despite the suggestion of associations between access to physiotherapy and survival noted irrespective of dementia diagnosis, and with discharge home, readmission, and recovery of indoor mobility only for those with dementia. The findings for discharge home are in keeping with a randomised controlled trial by Huusko and colleagues which indicated older adults with dementia in receipt of enhanced physiotherapy were less likely to reside in a care home at three months than those who received usual care [21]. There is a need to substantiate the evidence with respect to the optimal access to physiotherapy for patients with different severities of dementia in a larger cohort study. A randomised controlled trial seeking to detect a risk difference of between 3% and 6% for discharge home between two groups (≥2 hours vs <2 hours physiotherapy in the first postoperative week) with a power of 85% or higher and at the 5% significance level, would need between 1,232 and 4,929 participants in each arm of the trial which may not be financially viable or logistically feasible.

Limitations

This study has limitations which impact inferences about causation and generalisability. Whilst adjustment for observed potential confounders was made, results may be explained by residual confounding due to other patient (e.g., social capital, motivation) and care characteristics (e.g., surgery type and timing, differing organisation of rehabilitation across settings, hospital practices, discharge destinations). It is also possible results were confounded by indication, whereby patients with comorbidities require more physiotherapy to recover, but the extent of recovery is diminished by the nature of their comorbidities. Analysis was completed to assess the sensitivity to missingness and to the exclusion of patients discharged in the first seven days with similar results to the main analysis. Imputation was not completed for discharge home or recovery at 120-days as these data are unlikely to be missing at random. There was 56% data missingness for discharge home and recovery at 120-days, with differences between patients with and without data for this outcome (Supplementary File 3), limiting generalisability. The NHFD is populated by engaged clinical teams at each hospital in England and Wales. In the absence of dedicated staffing for follow-up data collection the degree of missingness may not be improved [22]. Finally, the analysis by dementia was based on the presence of an ICD-10 diagnosis code which does not give an indication of severity, or of the presence of cognitive impairment among those without an ICD-10 diagnosis of dementia.

CONCLUSION

Greater access to physiotherapy was associated with a higher probability of positive outcomes. For every 100 patients, greater access could have equated to an additional eight patients surviving to 30-days and six avoiding 30-day readmission. The findings also suggest a potential benefit in terms of home discharge and recovery of outdoor mobility. The association between access to physiotherapy and survival persisted irrespective of dementia diagnosis. For other outcomes, associations varied by the presence or absence of dementia and should be explored further by future cohort studies.

DECLARATIONS

Ethical approval

The study did not require NHS Research Ethics Committee approval as it involves secondary analysis of linked pseudo-anonymised data.

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Conflicts of interest

The Chartered Society of Physiotherapy Charitable Trust funding provides salary support for AG, and partial salary support for SA. KS also received funding from the NIHR Research for Patient Benefit and UKRI Future Leaders Fellowship for hip fracture health services research. KS is the Chair and AJ and CG are members of the Scientific and Publications Committee of the Falls and Fragility Fracture Audit Programme which managed the National Hip Fracture Database audit at the Royal College of Physicians. FCM was the funded (2012-2018) board chair and AJ is funded clinical lead of the Falls and Fragility Fracture programme. SA is funded by the NIHR Biomedical Research Centre based at Guy's and St Thomas' NHS Foundation Trust, King's College London. CS received funding from the National Institutes of Health Research for research not related to the current study. TS received funding from the National Institutes of Health Research for research not related to the current study. CLG receives funding from Versus Arthritis (ref 22086). ES is supported by the NIHR Applied Research Collaboration Wessex. The views expressed are those of the authors and not necessarily those of the National Health Service, the NIHR or the Department of Health and Social Care. OA, LB, IDC, BS, RMC, JM and MTK declare no conflicts of interest.

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