A cost-consequence analysis of a community-based rehabilitation programme following hip fracture (Fracture in the Elderly Multidisciplinary Rehabilitation—FEMuR III)

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ORIGINAL ARTICLE

A cost-consequence analysis of a community-based rehabilitation programme following hip fracture (Fracture in the Elderly Multidisciplinary Rehabilitation—FEMuR III)

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Abstract

Summary The FEMuR III economic evaluation presents costs and consequences of the intervention compared with usual care at 52-week follow-up. There was no evidence of clinical effectiveness in terms of improvement of quality of life, and the total health service costs were higher in the intervention group.

Purpose To explore the costs and consequences of the new FEMuR III intervention compared to usual care after hip fractures.

Methods This cost-consequence analysis accompanies the FEMuR III randomised controlled trial using a micro-costing approach. The main outcome measures in this economic evaluation were healthcare service use, costs, and quality of life over 12 months, from both National Health Service and wider societal perspectives. Quality of life was measured using the EuroQoL-5D-3L.

Results The mean cost of delivering the intervention was £444 per participant. For participants with complete EQ-5D data ($n = 142$), both groups showed improvement in EQ-5D index score, moving scores closer to UK norms. Participants in the intervention group gained 0.02 (95% CI: − 0.036, 0.076) more quality-adjusted life years (QALYs) than the usual care group. However, this was not statistically significant (p value = 0.312). For imputed cases, participants in the intervention group gained less QALYs than the usual care by 0.01 (95% CI: − 0.056, 0.030). For participants with complete cost data ($n = 115$), at 52-week follow-up, mean health service use costs were higher in the intervention group from both perspectives.

Conclusions The mean health service use costs were higher in the intervention group due to longer inpatient stays. There was no significant difference in QALYs between both groups. The trial was affected by the COVID-19 pandemic, and this goes some way to explaining the large proportion of missing data (40%).

Trial registration ISRCTN28376407.

Keywords Cost-consequence analysis · Health economics · Hip fractures · Quality of life · Rehabilitation

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Introduction

Hip fracture affects more than 72,000 people in England, Wales, and Northern Ireland in 2022 [1]. Hip fracture is associated with significant morbidity, including reduced hip function, loss of independence, and a 30% increased chance of mortality in the year after injury [2]. In individuals who experience a hip fracture, only 25% are likely to return to their pre-fracture functional capacity and 50% are unlikely to recover to their pre-fracture state [3].

Hip fractures are most common amongst elderly people (defined as being over the age of 65 in the UK) [2]. The most important risk factors of falls and fall-related injuries leading to bone fractures amongst elderly people are previous falls, cognitive impairment, chronic illness, and deficits in balance [4]. The management of hip fracture patients incurs considerable financial cost. Annually, hip fractures cost the UK National Health Service (NHS) £2 billion [5]. Hospital, community, and social care costs are four times greater in 1 year after admission for a fall than the costs of the admission itself [5]. Most costs occur outside of the acute hospital setting [5]. The prevalence of hip fractures increased during the COVID-19 pandemic [6]. In December 2022, 7000 hip fractures were observed across the UK, considerably higher than the 5500 per month average in the years prior to the pandemic [6].

Improved mobility-related outcomes are associated with early and high doses of mobility training [7]. Rehabilitation programmes should begin soon after hospital admission and continue after hospital discharge [7]. Rehabilitation training should include goal-directed mobilisation practice, including tailored balance and functional exercises to promote independence [8]. National Institute for Health and Care Excellence (NICE) guidance from 2023 stated that a randomised controlled trial (RCT) should be conducted to present the clinical effectiveness and cost-effectiveness of rehabilitation following hip fracture as there is a lack of robust evidence [2, 9–11].

A 2024 rapid review updating existing systematic reviews of clinical and economic effectiveness of hip fracture rehabilitation in older people identified only one additional previously unreported study of home-based rehabilitation [12]. The home-based rehabilitation was found to be cost-effective [13]. The review highlighted there is insufficient evidence to demonstrate clinical effectiveness or cost-effectiveness of care pathways for people with hip fracture after surgery, and therefore, further research is needed [2]. The enhanced rehabilitation programme (FEMuR III) was developed to improve activities of daily living in older people who experience hip fracture surgery [9, 10, 14]. The FEMuR III trial aimed to examine the effectiveness and cost-effectiveness of the enhanced rehabilitation programme following surgical repair of proximal femoral fracture in older people compared with usual care [9]. However, the FEMuR III trial was unable to evidence clinical effectiveness compared to usual care.

Purpose

A cost-consequence analysis (CCA) was conducted to present disaggregated costs and consequences of the intervention compared with usual care at 52-week follow-up.

Methods

FEMuR III is a phase 3, parallel-group, two-armed, superiority, pragmatic RCT. Participants were allocated with 1:1 ratio to either an enhanced rehabilitation or usual care group. For the enhanced rehabilitation group, participants received up to six additional rehabilitation sessions from physiotherapists, occupational therapists, or their assistants, who had been trained to deliver these extra sessions. Workbooks and diaries were provided to patients to create goals and monitor progress alongside rehabilitation sessions. Participants in the usual care group received usual care rehabilitation sessions delivered by a multidisciplinary team. The details of participants' recruitment and randomisation was published elsewhere [9].

This economic evaluation was conducted alongside the FEMuR III trial. Due to the FEMuR III intervention not being more effective than usual care, a cost-effectiveness analysis (CEA) was not applicable in this instance [15]. Therefore, we performed a CCA to allow readers to develop their own opinion on relevance and relative importance of findings [16, 17]. The logic model of FEMuR intervention was published elsewhere [18]. The health economic logic model summarises our approach to the economic evaluation of the FEMuR III trial (Fig. 1).

Measurement of costs

Community, hospital, and other services health resource use were collected using a bespoke self-reported Client Service Receipt Inventory (CSRI) questionnaire [19]. Due to the heterogeneity of pre-baseline health resource use (Supplementary file), this analysis focusses on healthcare resource use between baseline (week 0 after randomisation) and final follow-up (52-weeks). We assume baseline equivalence between control and intervention arms.

Health resource use costs were calculated by multiplying unit costs for respective health resource contacts. Unit costs were obtained from the Personal Social Services Research Unit (PSSRU) Unit Costs Manual 2023 [20] and

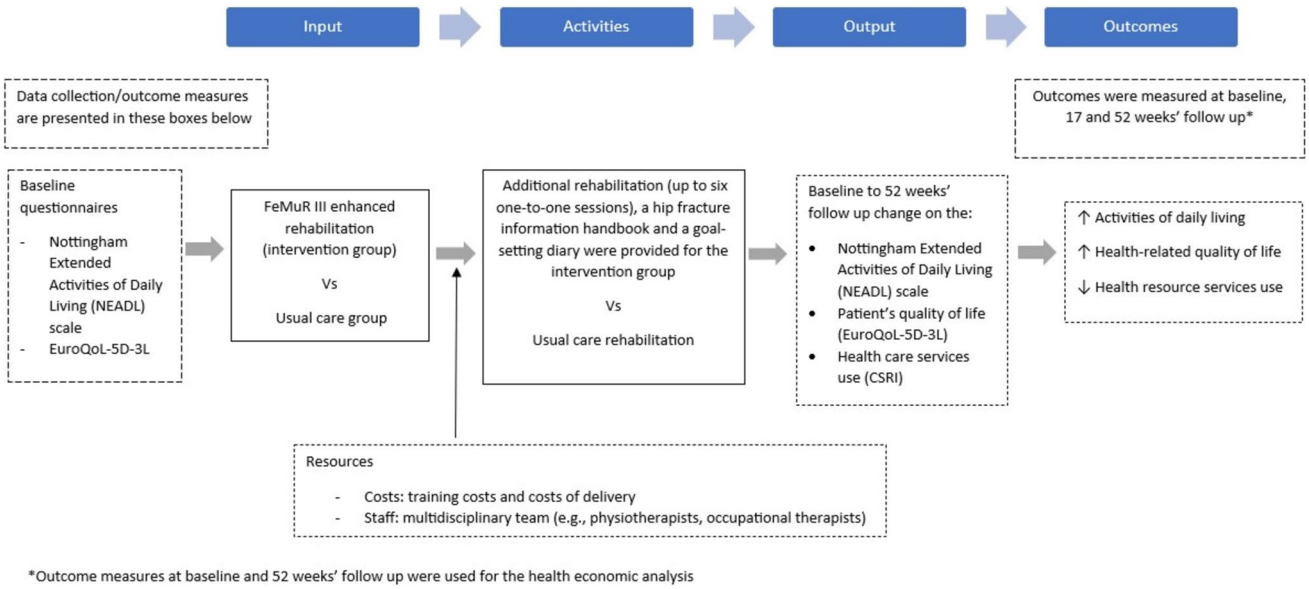

Fig. 1 The health economic logic model for the FeMuR III trial

the National Schedule of NHS Costs 2021/22 Version 3.0 [21] (Supplementary file). For hospital inpatient stays, participants provided reasons for stays in free text. The reasons for hospital inpatient stay were matched with corresponding healthcare resource group (HRG). Non-elective spell costs were used for each HRG. For participants who stayed longer than trim point, an excess bed day cost was applied. Health resource use was costed in British pounds sterling (£) for cost year 2022/23. For patients who received/paid for private care, unit costs were obtained from UK private providers (Supplementary file).

Measurement of outcomes

Health-related quality of life (HRQoL) was measured using the self-reported EuroQoL-5D-3L (EQ-5D-3L) [22]. Mobility, self-care, usual activities, pain/discomfort, and anxiety/depression are the five dimensions of the EQ-5D-3L descriptive system. Each dimension has three response levels: no problems, some problems, and extreme problems [22]. An index score of 1 represents full health and 0 represents a health state equivalent to being dead [22, 23]. The EQ Visual Analogue Scale (VAS) is a secondary question administered as part of the EQ-5D asking participants rank their overall health on vertical scale from 0 to 100 [22].

Training and delivery of the intervention

The costs of training and delivery of the intervention were calculated using a bottom-up, micro-costing approach (where every component of resource use is accounted for and valued using unit costs) [24]. To calculate training costs, staff time and the costs of travel and accommodation for trainers were captured. Cost of staff time included the time of the trainers delivering training as well as clinical trainees receiving training. Staff time was costed through multiplication of hours of training session with unit costs per working hour for all attending staff. For delivery costs, the mean delivery costs of the intervention and usual care group per participant were costed and presented in the nearest (£) with standard deviation (SD).

Data analysis

Mean costs of healthcare resource use per participant were calculated and presented to the nearest £ with SD. The mean EQ-5D-3L index scores were calculated and presented with SD for participants with complete data for the first instance. Complete data cases represent all participants with no missing data between baseline and 52-week follow-up. This complete case sample included participants who died during the trial. QALYs over the 52-week trial period were calculated from the EQ-5D-3L index score using area under the curve method [16, 25]. Missing data on EQ-5D score were imputed with multiple imputations by chained equations, assuming data was missing at random (since there was no evidence that the missing data depended on baseline participant characteristics or any particular factors). Fifty imputed datasets were created using linear regression. Imputation was performed by type of fracture. After imputation, means were estimated using linear regression models controlling for age, type of fracture, co-morbidity, and gender.

Change in total health resource use costs and QALYs per participant are reported with 95% confidence interval (CI),

estimated using non-parametric bootstrap sampling. Five thousand replications were performed for each CI and bias corrected and accelerated CIs are shown. The minimum clinically important difference for EQ-5D was 0.074 [26]. If the data was normally distributed, independent *t*-test was used to compare the significance of the mean difference between groups with p-value significance level of 0.05. If the data was skewed, independent Mann–Whitney *U* test was used instead with *p*-value significance level of 0.05.

For participants who died during the trial, we collected health resource use costs up until 17 weeks. This trial had 2 follow-up points post-baseline at 17 and 52 weeks. Thus, for anyone who died after 17 weeks, we included health resource use costs and EQ-5D-3L index scores until 17 weeks. For participants who died before 17 weeks follow-up, we assigned health service use costs of £0. For EQ-5D-3L index scores in participants who died, we assigned EQ-5D-3L index score of 0 (state equal to death) [23].

As the intervention follow-up period is 1 year, we did not discount costs and QALY outcomes. The base-case analysis was conducted from a public (NHS) perspective. Wider societal perspective was applied to capture private, and third sector costs incurred by participants. All analyses were carried out using Microsoft Excel, SPSS version 29.0.1.0 and STATA.

Subgroup and sensitivity analysis

Subgroup analysis was performed to explore the effects of gender and age on resource use costs and QALY outcomes. Sensitivity analyses were undertaken to examine uncertainty that can affect service use costs and QALYs. This was achieved through removing outliers using multiple imputation approach. Outliers were identified by interquartile (IQR) range method. Any costs less than quartile 1-(1.5* IQR) or higher than quartile 3-(1.5*IQR) were defined as outliers.

Results

Participant demographics

Two hundred five participants were recruited to the FEMuR III trial. However, two participants had error in randomisation. Therefore, 203 were included in this trial. One hundred were allocated to the usual care group and 103 were allocated to the intervention group. Twenty participants died during the trial. The mean age of participants in the usual care and intervention groups were 84.7 years and 84.9 years, respectively. Baseline characteristics of participants from both groups were comparable (Table 1).

Table 1 Baseline characteristics of participants ($n = 203$)

Intervention group ($n = 103$) Usual care group ($n = 100$)	Intervention *n* (%)	Usual care *n* (%)
Age, mean (SD)	84.9 (7.99)	84.7 (8.07)
Female	71 (69%)	68 (68%)
Type of hip fracture		
Intracapsular	56 (54%)	60 (60%)
Extracapsular-pertrochanteric	3 (3%)	4 (4%)
Extracapsular-inter-trochanteric	26 (25%)	20 (20%)
Extracapsular-sub-trochanteric	6 (6%)	7 (7%)
Type of hip surgery		
Total hip replacement	9 (9%)	16 (16%)
Hemi-arthroplasty	44 (43%)	31 (31%)
Internal fixation	32 (31%)	29 (29%)
Intra-medullary nailing	13 (13%)	20 (20%)
Living arrangement		
Alone	49 (48%)	52 (52%)
With others	54 (52%)	48 (48%)
Comorbidity		
Yes	83 (81%)	82 (82%)
No	20 (19%)	18 (18%)
Ethnicity		
White	101 (98%)	98 (98%)
Any other ethnic groups*	2 (2%)	1 (1%)
Educational attainment		
High school (O Levels/GCSE/NVQ1)	21 (20%)	28 (28%)
College (AS Level/A Levels/City and guilds NVQ2/3 Apprenticeship)	21 (20%)	18 (18%)
Degree	6 (6%)	8 (8%)
Higher degree (MA/PHD/PGCE)	5 (5%)	3 (3%)
No formal qualifications	26 (25%)	24 (24%)
Missing data	24 (24%)	19 (19%)

*American, European, and White Canadian

Health-related quality of life

Overall, 122 participants completed the EQ-5D-3L at both baseline and 52-week follow-up. The 20 participants who died were included in this complete case sample. This sample represents 70% of the full trial sample. Baseline characteristics of this subsample were comparable to the overall sample ($n = 203$) (Supplementary File).

At baseline, mean EQ-5D-3L index scores were slightly higher in the intervention group (0.53 intervention, 0.51 usual care). Participants in the intervention group (0.65) had a greater improvement in EQ-5D-3L index scores at 52-weeks compared to usual care (0.59) (Table 2). The mean EQ-5D scores for both groups at baseline were lower than the UK population norm for those aged 75 years or over (0.73).

Table 2 The EQ-5D-3L at baseline and 52-week follow-up for complete cases ($n=142$)

Intervention group ($n=73$) Usual care ($n=69$) EQ-5D-3L index score	Baseline (mean, SD)	52 weeks (mean, SD)	Mean quality-adjusted life year gained at 52 weeks (QALYs, 95%CI)	Mean different of QALYs between group (intervention-usual care) (QALYs, 95%CI)	p value
Intervention group	0.53 (0.169)	0.65 (0.291)	0.06 (0.020, 0.094)	0.02 (−0.036, 0.076)	0.312
Usual care group	0.51 (0.199)	0.59 (0.318)	0.04 (−0.003, 0.080)		
EQ-5D-3L VAS score	Baseline (mean, SD)	52 weeks (mean, SD)	Mean difference between baseline and 52 weeks (95%CI)	Mean different between group (intervention-usual care) (95%CI)	p value
Intervention group	58.6 (22.77)	59.3 (31.03)	0.75 (−8.673, 9.792)	1.84 (−10.687, 14.369)	0.796
Usual care group	58.8 (21.76)	57.7 (29.98)	−1.09 (−9.989, 7.309)		

Due to skewed data, independent-sample Mann–Whitney U test was used to compare the difference in mean between groups at p value significant level 0.05

At 52-week follow-up, participants from the intervention group gained higher QALYs than usual care by 0.02 (95% CI: −0.036, 0.076). However, this difference was neither statistically significant (p-value = 0.312) nor clinically meaningful. Participants in the intervention group reported greater improvement of VAS score at 52-week follow-up than the usual care group by 1.84 (p-value = 0.796) (Table 2).

In the imputed case sample, participants in the intervention group showed lower improvements in QALYs than participants in the usual care group by 0.01 (95% CI: −0.056, 0.030). However, this difference was neither statistically significant (p-value = 0.645) nor clinically meaningful (Table 3).

FEMuR III intervention training costs

In each of the 13 sites, two trainers delivered the FEMuR III training. One trainer was a physiotherapist (Band 7) (£63 per working hour), and the other was an academic general medical practitioner (£63 per working hour). These trainers had to travel to each site to deliver the training. The average travel and accommodation costs were £100 per session. Each training session lasted 4 h and was delivered typically to two physiotherapists (Band 6) (£53 per working hour).

The mean training cost of FEMuR III per site was £1,028 (Eq. 1):

$$4(£232.01) + £100 = £1{,}028 \quad (1)$$

where £232 is the sum cost per working hour for 2 × Band 6 physio, 1 × Band 7 physio, and 1 × Consultant.

Multiplying the mean training costs by 13 for the number of sites, the total FEMuR III training costs were £13,364.

Intervention delivery costs

The mean total rehabilitation sessions provided were 7 (SD: 5.67) for the intervention group and 5 (SD: 7.30) for the usual care group. The median number of rehabilitation sessions were 6 [IQR: 3] and 3 [IQR: 4] for the intervention and usual care groups, respectively. Mean delivery costs per participant were £444 (SD: 336.76) for the intervention group and £157 (SD: 189.89) for the usual care group.

Table 3 The EQ-5D-3L at baseline and 52-week follow-up for imputed cases (n=203)

Intervention group ($n=103$) Usual care ($n=100$) EQ-5D-3L index score	Baseline (mean, SD)	52 weeks (mean, SD)	Mean quality-adjusted life year gained at 52 weeks (QALYs, 95%CI)	Mean different of QALYs between group (intervention-usual care) (QALYs, 95%CI)	p value
Intervention group	0.51 (0.192)	0.59 (0.280)	0.04 (0.008, 0.073)	−0.01 (−0.056, 0.030)	0.645
Usual care group	0.53 (0.174)	0.64 (0.264)	0.05 (0.023, 0.080)		

Due to skewed data an, independent-sample Mann–Whitney U test was used to compare the difference in mean between groups at p value significant level 0.05

Health resource use

Due to the high percentage of missing data in health resource use (around 40%), we decided to present complete cases only.

Complete cases sample (n = 115)

The most commonly used health resource in community-based services for both groups was the district nurse. The intervention group had higher frequency of district nurse and general practitioner (GP) visits than usual care. The usual care group had a higher frequency of visiting practice nurses at a GP clinic.

Regarding hospital service use, both groups reported similar frequency of total admissions, outpatient, and accident and emergency attendances. The average inpatient length of stay (LOS) was approximately 5 days longer for the intervention group (Table 4).

Health resource use costs

Complete cases (n = 115)

NHS perspective One hundred fifteen participants had complete cost data. This figure includes 20 participants who died before 52-week follow-up, 56 participants from the intervention group, and 59 participants from the usual care. These complete cases represent 57% of the full trial sample size. The baseline characteristics of this sample are presented in Supplementary file.

At 52-week follow-up, inpatient stay costs were the highest contribution of total health care cost for both groups. There was a statistically significant difference in the mean total hospital inpatient stay costs between groups ($p = 0.043$). In the intervention group, hip-related hospital inpatient stay costs accounted for 40% of the total inpatient stay cost. The other 60% of costs were attributable to non-hip related conditions. For the usual care group, only 13% of total inpatient stay costs were attributed to hip-related inpatient stays (Supplementary file).

Table 4 Health resource use over 52-week follow-up, mean (SD)

Parameter (visits)	52 weeks	
	Intervention	Usual care
Community-based service use		
General practitioner (GP)	2.7 (3.25)	1.9 (1.90)
Practice nurse (GP Clinic)	1.1 (1.23)	4.4 (10.10)
District nurse	21.8 (47.44)	14.8 (52.97)
Hospital service use		
Number of admissions	1.1 (0.91)	0.8 (0.83)
Length of admission (days)	13.6 (20.14)	8.7 (8.51)
Outpatient service	2.3 (1.54)	2.7 (2.01)
Accident and emergency	1.4 (0.60)	1.4 (0.51)

The mean total health resource use costs were £3,332 (SD: 5,343.94) for the intervention group and £1,713 (SD: 4,191.25) for the usual care at 52-week follow-up (Table 5). After removing outliers, the mean total health resource use costs for complete cost data were still higher for the intervention group, £1,358 (SD: 2,639.00) than usual care, £679 (SD: 1,245.39) (Supplementary file).

Wider societal perspective The mean total health resource use costs were £3,346 (SD: 5,342.97) for the intervention group and £1,734 (SD: 4,224.39) for usual care at 52-week follow-up (Table 5). Inpatient stay costs are the costliest element, as was the case from the NHS perspective. No statistically significant difference in the mean total hospital inpatient stay costs was found (p-value = 0.057) (Supplementary file).

From both perspectives, the intervention group had greater health service use costs. This was due to high non-hip-related inpatient stay costs and longer average LOS for the intervention group (Table 5).

Results of subgroup analysis

No difference in QALY gain between males or females was found in the intervention group. In the usual care group, males gained no QALYs at 52-week follow-up, while females gained 0.05 QALYs, the same as in the intervention group (Supplementary file).

Younger participants gained more QALYs than other age groups. Older age in the intervention group was associated with reduced QALY gains. In the usual care group, participants in the usual care group gained lower QALYs than the participants in the intervention group across each age category except the 70–79 years group (Supplementary file).

In the subgroup analysis of total healthcare resource use costs, males in the intervention group had considerably higher mean total costs than females. However, this result was opposite in the usual care group. No clear patterns of mean healthcare resource use cost were observed between age categories (Supplementary file).

Discussion

Principal findings

Delivery costs were higher for the intervention group than usual care. These increased costs can be attributed to the

Table 5 The cost-consequences balance sheet (complete cases)

Cost (£, SD) 2022/23 cost year	NHS perspective		Difference between groups (95%CI)	Wider societal perspective		Difference between groups (95%CI)	
	Intervention	Usual care		Intervention	Usual care		
Mean total community-based service use costs	£369 (738.88)	£287 (729.22)	£83 (−198.85, 364.05)	£363 (733.70)	£291 (735.62)	£71 (−210.29, 353.20)	
Mean total hip-specific service use costs	£58 (173.67)	£8 (25.00)	£49 (−80.28, 178.81)	£72 (183.46)	£7 (19.96)	£66 (−20.34, 151.40)	
Mean total hospital inpatient stay costs	£5130 (5753.65)	£2838 (5658.53)	£1564 (−846.33, 5431.40)*	£4968 (5731.50)	£2838 (5658.53)	£2127 (−981.40, 5235.47)	
Mean total hip-related hospital inpatient stay cost	£2032 (3722.45)	£361 (1107.17)	£1670 (90.04, 3250.74)	£1966 (3678.00)	£361 (1107.17)	£778 (44.24, 3165.46)	
Mean total hospital-based service use costs	£3862 (5471.27)	£1995 (4481.06)	£1868 (−276.87, 4012.50)	£3775 (5438.54)	£2031 (4528.77)	£1082 (−408.29, 3894.61)	
Mean total hip-related hospital costs	£1074 (3122.40)	£318 (950.93)	£756 (−238.78, 1749.89)	£1482 (3276.66)	£320 (950.53)	£1162 (129.59, 2195.06)	
Mean total health service use costs	£3332 (5343.94)	£1713 (4191.25)	£1620 (−149.71, 3389.07)	£3346 (5342.97)	£1734 (4224.39)	£1612 (−171.99, 3396.25)	
Delivery cost	£444 (336.76)	£157 (189.89)	£287 (793.83, 379.37)	£444 (336.76)	£157 (189.89)	£287 (793.83, 379.37)	
Mean total health costs including cost of intervention	£3709 (5523.04)	£1928 (4552.71)	£1786 (−353.62, 3924.66)	£3728 (5520.67)	£1923 (4552.66)	£1805 (−333.50, 3943.59)	
Consequences	Baseline		52-week follow up		Mean QALYs gained at 52 week (95% CI)		Difference between groups (95%CI)
Health-related quality of life	Intervention	Usual care	Intervention	Usual care	Intervention	Usual care	
Mean EQ-5D-3L index scores (SD)	0.53 (0.169)	0.51 (0.199)	0.65 (0.291)	0.59 (0.318)	0.06 (0.020, 0.094)	0.04 (−0.003, 0.080)	0.02 (−0.036, 0.076)
Mean EQ-5D-3L VAS scores (SD)	58.6 (22.77)	58.8 (21.76)	59.3 (31.03)	57.7 (29.98)	NA	NA	NA

*There was a statistically significant difference between groups ($p = 0.043$)

greater number of rehabilitation sessions in the FEMuR III intervention compared to usual care. These findings are consistent with the FEMuR feasibility trial. However, the mean delivery cost per participant were higher in the full-scale RCT [14].

Participants from both groups reported higher EQ-5D index score (0.65 for intervention and 0.59 for usual care) than participants with hip fracture from the Warwick Hip Trauma study (0.57) [27]. The improvement in EQ-5D-3L index score is in line with the results of home-based and hospital-based rehabilitation in Taiwan [13]. The gain in QALYs of complete cases in this full-scale RCT was the same as in the feasibility study (0.02 QALYs) [14].

Regarding hospital service use, both groups reported similar frequency of total admissions, outpatient, and accident and emergency attendances, further falls requiring hospital treatment, and further hip fractures. The average inpatient LOS was 5 days longer for the intervention group. The LOS observed in this trial is consistent with national records of patients admitted with hip fracture in England and Wales between 2016 and 2019, ranging from 12 to 42 days [28]. Inpatient stay was the largest component of total health care cost for both groups. However, non-hip-related conditions accounted for the majority of total health care cost for both groups. This indicates high prevalence and severity of comorbidity in this trial cohort. Mean total health resource use costs were higher in the intervention group, from both NHS and wider societal perspectives. The results were consistent when outliers were removed. The longer inpatient LOS for the intervention group explains some of the increased costs. These findings are consistent with the findings of the FEMuR feasibility trial [14].

Strengths and limitations of the study

This is the first health economics study to investigate the cost of a multi-agency hip fracture rehabilitation programme in England and Wales. As identified in the prior scoping review, this study contributes to a limited economic evidence base in hip rehabilitation [12]. The similarity of findings between the full economic evaluation and feasibility trial show robustness of the results and trial methodology. The FEMuR feasibility trial used a wider range of outcome measures (ICECAP-O and EQ-5D-3L). The EQ-5D has been shown to exhibit good responsiveness for people with hip fractures who are aged 65 and over [14, 28]. The ICECAP-O was not sensitive to change or acceptable for participants [14] so was not included the FEMuR III study which we report here. However, the EQ-5D with five response levels (EQ-5D-5L) may have better captured the change of health status of participants than EQ-5D-3L by being more sensitive.

This is the first-time subgroup analysis has been undertaken in an economic evaluation of a hip rehabilitation RCT. However, the results of subgroup analysis are underpowered due to low sample size in this instance.

Of relevance to the findings of this economic evaluation are the issues of missing data. This evaluation presents findings from both complete case and imputed data sets. Over 40% of the main trial sample had a form of missing data on CSRI. This is likely influenced by data collection processes moving to remote/virtual collection because of the COVID-19 pandemic. For the feasibility study, data was collected from researchers administering questionnaires in participants' homes. The rate of missing data when collected this way was around 10% [14]. Missing data is a known issue in economic evaluations and improper treatment of missing data can skew results. Presenting complete cases may not represent participants with missing data. The recruitment and retention issues this trial encountered are shared in other contemporary studies conducted during the pandemic period [13].

Policy implications

The COVID-19 pandemic impacted the fidelity of the FEMuR III intervention in terms of the mode of delivery, with many sessions delivered remotely, and also the number of sessions delivered was lower than planned. The FEMuR III intervention was not found to be more effective than usual care. Therefore, our economic evaluation was limited to a CCA. As a result, we do not report an incremental cost-effectiveness ratio (ICER) recommended by NICE and commonly used in policy making. For complete case analysis, participants in the intervention group gained higher QALYs than participants in usual care, but this was of doubtful clinical importance. However, the mean total health resource use costs were higher for the intervention group. The results of the disaggregated CCA allow readers to develop their own opinion on relevance and relative importance of findings [16, 17].

Conclusion

There was no evidence of clinical effectiveness in terms of QALYs gained in the intervention group, despite total health service costs being higher in this group. This was largely because of higher, non-hip related inpatient costs in the intervention group. All trial procedures were adversely affected by the COVID-19 pandemic, which may explain the large proportion of missing data.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s00198-025-07459-4.

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Declarations

Ethics approval NHS research ethics approval was obtained from North East—Tyne & Wear South Research Ethics Committee, reference 18/NE/0300.

Conflicts of interest NHW is deputy chair of NIHR HTA funding committee (commissioned research). KD, JD, VE, LHS, and RTE declare that they have no conflict of interest.

Disclaimer The views and opinions expressed therein are those of the authors and do not necessarily reflect those of the HTA, NIHR, NHS or the Department of Health.

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