

Family-based transitional care for older adults after hip fracture surgery: a feasibility study

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Abstract

Background Older adults with hip fracture surgery often face considerable physical and psychological impacts during the transition from the hospital to home and require family caregivers to provide assistance with daily activities and rehabilitation. Therefore, it is essential to empower both patients and family caregivers with effective care management to support recovery and improve health outcomes.

Methods This study aimed to assess the feasibility and preliminary effectiveness of implementing a family-based transitional care program after hospital discharge in older adults with hip fracture surgery. The program components, integrated into a mobile application, were developed and guided by Meleis' theory of transition and the concept of Family-based illness care. Health outcomes, including hip function, activities of daily living, mobility function, and fear-of-falls measures, were evaluated in 16 Thai families (including older adults and their primary caregivers) before discharge, at two weeks, and at six weeks post-discharge. The program's feasibility was evaluated by older patients' families and healthcare providers after its implementation. Descriptive statistics and Repeated-Measures Analysis of Variance were used in the analysis.

Results The program was feasible and satisfactory for implementation in transitional care for older adults following hip fracture surgery. The preliminary results found significant improvement in all health outcomes, including hip functions ($F=254.72, p=.00$), activity of daily living ($F=230.55, p=.00$), mobility function ($F=159.63, p=.00$), and fear of falling ($F=155.68, p=.00$) throughout the recovery process.

Conclusions The family-based transitional care program highlights the integration of a mobile application to assist healthcare providers and support families during the transition. It is feasible to use, and possible to improve health outcomes in older adults undergoing hip fracture surgery. However, a larger sample size and a more rigorous evaluation of the program's effectiveness through a randomized controlled trial are recommended for future studies.

Keywords Family-based care · Hip fracture surgery · Hospital discharge · Older adults · Transitional care

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Background

Hip fractures are a common health problem in older adults and continue to increase globally. Such fractures are commonly a consequence of falls and osteoporosis [1, 2]. In the past three decades (1990–2019), the incidence rate rose by 92.7%, and it's projected that hip fractures could reach 89 million globally by 2050 [3]. In Thailand, the incidence of hip fractures has risen annually since 2013, with the incidence (per 100,000 population) increasing from 112.7 to 146.9 in 2022, and the annual hospitalization costs for hip fractures increased [4].

After hip fracture surgery, additional physical and psychological impacts have been found in most older adults due to physical pain and limited mobility. Complications reported include joint stiffness, muscle atrophy, pressure ulcers, and infections [5]. Such complications can lead to greater dependence on families and a progressive functional decline, making it difficult to return to their pre-fracture functional and social status [6]. In addition, such problems can lead to mental health issues that may affect physical health and daily functioning, resulting in depression and abnormal perception [7]. Thus, older patients must rely on family caregivers for assistance with daily activities and rehabilitation after hospital discharge [5, 8, 9].

During the transition of care from the hospital to the home, there has been a well-documented breakdown in health information, education sharing and uptake, role confusion, and disorganized patient discharge planning [10]. These barriers necessitate robust transitional care to ensure a safe transition from hospital to home. Research indicates that effective transitional care relies on comprehensive discharge planning, caregiver education, and post-discharge coordination to maintain continuity of care [11, 12]. Moreover, safety-promoting programs have predominantly focused on assessing functional abilities, activities of daily living, fall risk, and overall health-related quality of life [6]. However, it has missed on family involvement and empowering families to care for themselves.

Several key factors influencing functional recovery in older adults in home care, after discharge from hip fracture surgery, include fear of falling, risk of depression, and limited social support [13]. Specifically, 47.4% of patients reported a high fear of falling, which led to activity avoidance and contributed to muscle weakness and impaired overall musculoskeletal function [14, 15]. Conversely, patients without depression and with strong family support demonstrated better functional recovery and improved performance in daily living activities [13].

Family-based care refers to the family dynamics of relationships among individuals living together, such as family members who support one another in roles and responsibilities [15, 16]. It emphasizes the involvement of both patients and their family caregivers in managing illness and its effects on family life. Strong, supportive family relationships can provide essential care and advice [11, 17, 18].

In Thailand, to date, care programs for older adults and their family caregivers following hip fracture surgery focus primarily on either patients or their caregivers [19–21]. Only a few studies consider both groups together [22, 23]. Moreover, interventions provided during hospitalization are seldom followed up by after discharge, and outpatient departments report attendance deficits. Although there have been advancements in care guidelines and models aimed at improving the quality of care for this patient group [24–27], these developments tend to concentrate on nursing guidelines or care models within a hospital context, such as the establishment of fast-track systems [24, 25]. Due to the demands of care within home environment and strategies to facilitate home-based recovery [28, 29], it is essential to develop a family-based transitional care program aimed at improving health outcomes for older adults who have undergone hip fracture surgery. The program's feasibility was tested for further development to ensure safety and benefit to individuals, organizations, and society.

Study aim

To assess the feasibility and preliminary effectiveness of implementing a family-based transitional care program after hospital discharge in older adults with hip fracture surgery. The feasibility included adaptability, content,

accessibility, acceptability, and satisfaction. The preliminary effectiveness measures of health outcomes in this study included hip function, activities of daily living, mobility function, and fear of falling.

Methods

Theoretical framework

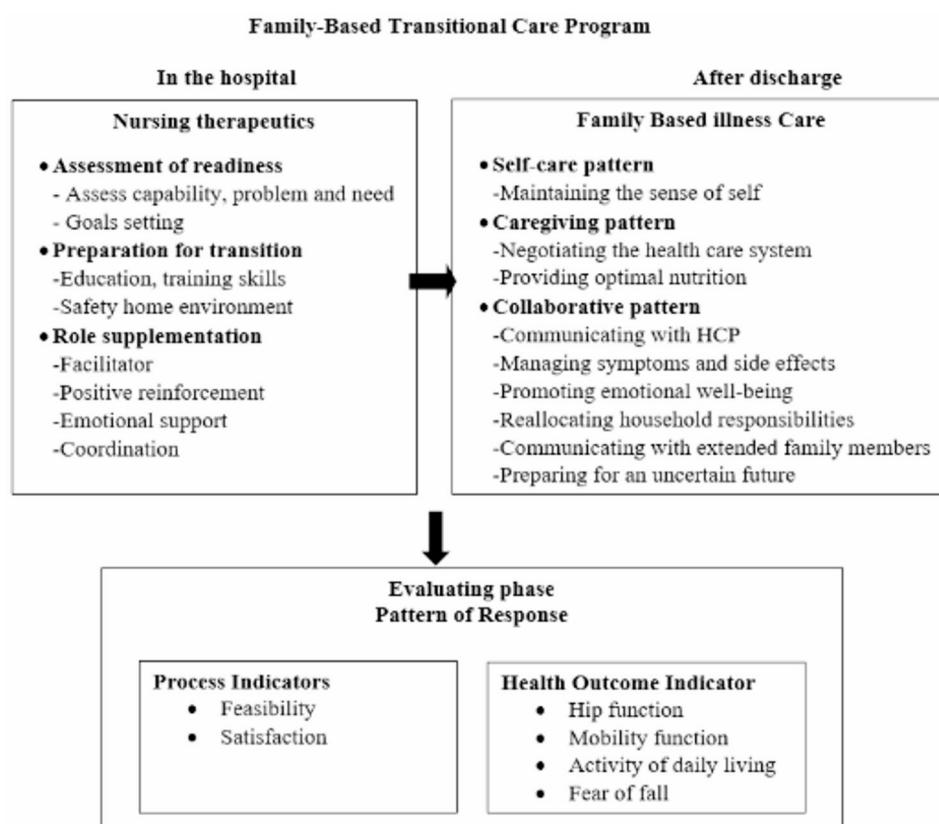
The program was developed based on Meleis's theory of transition [30] integrating the concept of family-based illness care [31] as well as related literature regarding older adults with hip fractures. Transition theory has been applied in discharge planning to prepare patients and their family caregivers for hospital-to-home discharge.³⁰ The theory provides a holistic framework for nursing therapeutics, including assessment, preparation, and role supplementation, which guides nurses in selecting appropriate strategies to support patients and families during the transition period.

In addition, the integration of family-based illness care [31] enhances quality of care through three distinct patterns of family involvement: (1) self-care, where individuals primarily manage their own illness; (2) caregiving, where illness management mainly relies on the actions of caregivers; and (3) collaborative care, where illness management is addressed through cooperative efforts. (Fig. 1)

Design and setting of the study

This study formed part of a broader research and development project focused on the development of a family-based transitional care program for older adults following hip fracture surgery. The present study evaluated the

Fig. 1 Conceptual framework of the study



feasibility and preliminary effectiveness of the program guidance by Pearson and team [32]. using a single-group pre–post design. Outcomes assessed as preliminary effectiveness included hip function, activities of daily living, mobility, and fear of falling, measured at three time points: prior to hospital discharge, at two and six weeks post-discharge. Program feasibility and satisfaction among family participants and healthcare providers involved in transitional care were evaluated at the completion of the six-week program.

The study was conducted in the orthopedic ward at a public hospital and the community in Songkhla Province in Thailand. To support post-discharge recovery, the hospital utilizes a continuing care center and an intermediate care unit, providing coordinated services across the community and home settings.

Participants and recruitment

There were two groups of participants, including 16 families (both patients and primary family caregivers) of older adults with hip fractures and 20 registered nurses, regarding the inclusion and exclusion criteria.

Inclusion criteria for older patients were aged 60 years, who were scheduled for hip fracture surgery, had no cognitive dysfunction (Mini-Cog ≥ 4 points), no depression (2Q = 0 points), and absence of serious chronic diseases, such as heart, liver, and lung diseases. Older patients who had limb dysfunction prior to fracture were excluded from the study. In addition, the presence of a family caregiver who was the primary caregiver was defined as those providing the majority of care for the patient during hospitalization and transition to home.

For registered nurses, the inclusion criteria were working for more than six months in intermediate care services, including orthopedic wards, continuing care units, or community settings, and willingness to participate in this research. Nurses who worked in the services as a part-time job were excluded from the study.

The sample size and power for families were calculated in a small group for the effectiveness trial to ensure that implementation measures and outcomes provide sufficient precision for useful estimates [32]. It was calculated based on a prior study of older adults with hip arthroplasty, which reported a large effect size of 1.22 [33]. Given that the current study utilized a one-group, repeated-measures design across three time points, a more conservative effect size of 0.40 (large effect size) was used for the power analysis to ensure robustness and to account for the difference in study design between the previous literature and the current one-group approach. Using the G*Power 3.1 program, with the alpha level at 0.05, power at 0.8, the estimated sample size was 12 participants. To account for a potential 30% dropout rate, the target recruitment was increased to 16 participants. There were 20 registered nurses who were eligible and participated in the study.

Family-based transitional care program

This program and interventions were developed based on the problems and needs of stakeholders (patients, family caregivers, and healthcare providers in transitional care) in real-world settings, as well as on literature reviews [23, 28, 29, 34–37]. It was designed to encourage both patients' and primary family caregivers' involvement in learning and caring throughout the discharge process.

The program consists of nursing therapeutic transition and promotes family care patterns, which are divided into two phases: in the hospital and post-discharge phase. (Fig. 2) There are eight components, including (1) Assessment, (2) A team-based approach, (3) Health education, (4) Patient and caregiver training, (5) Rehabilitation, (6) Motivating intervention, (7) Follow-up and monitoring, and (8) Referral information and reports, as shown in Table 1. The program was investigated and delivered by the first author.

In addition, the Hip Fracture Care Line Official Account (Line OA) was used as a tool to assist patients and their family caregivers in learning skills, health education, and as a communication channel between the family and the healthcare provider during the transition. The health care provider used Line OA to provide information, advice, and follow up with the patient and family through direct messages and video calls. The Hip Fracture Line OA included six main features: (1) Motivating Videos, (2) Care Videos for Patients and Caregivers, (3)

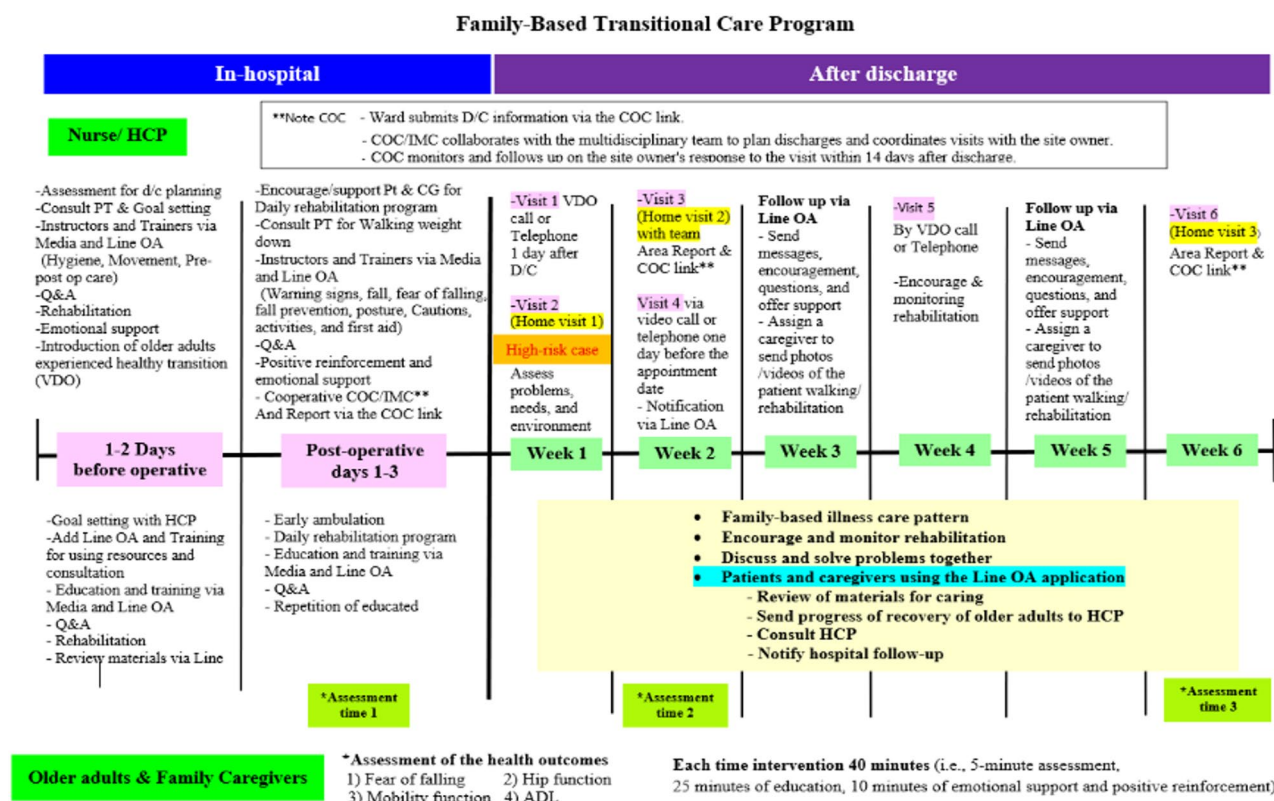


Fig. 2 Family-based transitional care program

Frequently Asked Questions, (4) Locating Nearby Social Care and Assistance Centers, (5) Video Downloads, and (6) Health Consultation Channels.

In the hospital phase, the program was offered for approximately one week, starting from pre-operative care until discharge home following surgery. Participants were invited to join the Hip Fracture Care Line Official Account (OA) and receive initial instructions for using the resource upon admission to the ward. Flexible arrangement with family were held at hospital phase to cover the preoperative (one–two days), immediate postoperative (days one–three post-operation), and pre-discharge periods (one–two days). Using the Hip Fracture Care Line OA platform, patients and their caregivers engaged with educational media. The program created a daily checklist of nursing interventions suitable for each timeframe and patient status. Each intervention, utilizing nursing therapeutics, lasts 40 min (i.e., 5 min of assessment, 25 min of education, 10 min of emotional support and positive reinforcement).

Post-discharge phase, continuing care after discharge from the hospital to home was delivered, including three home visits and three VDO/telephone visits over six weeks from the Intermediate Care (IMC) team or local community healthcare providers. Three home visits were provided at (1) the first week after discharge, aiming to assess the home environment and boost confidence for patients and caregivers, particularly in high-risk cases (e.g., hazardous home environments, risk of wound or urinary tract infections, less mobility, and limitations in family caregiving, such as being left alone during the day), (2) the second week after discharge with the Intermediate Care (IMC) team or local community healthcare providers; and (3) the sixth week after discharge for overall evaluation. The three VDO calls/ telephone visits via the Hip Fracture Care Line OA platform were arranged on the day of discharge, in the second week, and the fourth week. Follow-up and notifications were also sent via Line OA messages, scheduled one day in advance prior to the hospital appointment. It helps by offering encouragement, answering questions, and providing support.

Table 1 Components of family-based transitional care program

Components	Interventions
1) Assessment	- Demographic data, awareness of the operation, nutrition, the need for family caregiving, risks of falling, fear of falling, and the home environment. - Home visit /Telephone or video call after discharge to inquire about problems and needs at home. - Monitoring and assessing rehabilitation progress via personal chat on the Line OA application after discharge.
2) A team-based approach	- The orthopedist consults with the internal medicine physician to consider surgery. - Physical therapists rehabilitate and train gait and mobility. - Nurses stimulate early ambulation and rehabilitation in bed, coordinate care, and plan discharge. - Continuing Care Center, IMC team, and community nurses provide continuous care to patients in the community. Referral information and case reports via the COC link system - Local government provides medical equipment loans and transportation services. - Healthcare providers can advise and guide participants via Line OA private chat.
3) Health education	- Use videos/images as teaching media on iPad, computer, or the Line OA application on a smartphone. - Participants can review knowledge through the Line OA application as needed. - A daily checklist of nursing interventions suitable for each timeframe and patient status (care and health education) - Education highlights warning signs, fear of falling, and fall prevention, cautions, daily activities, and home environmental adjustments.
4) Patient and caregiver training	- Physical therapy on the bed, walking practice with a walker, mobility, and movement. - Daily activities such as turning the patient on their side, bed bath, sitting, standing, putting on pants, and shoes, etc. - Participants can review and practice the skills following the media in the Line OA application as needed.
5) Rehabilitation	- Pre-postoperative exercise - Daily rehabilitation program including ankle pumps, quadriceps sets, supine leg sides for flexion of hip, active-assisted abduction and adduction of hip and upper extremities - Participants can review and rehabilitation following the media in the Line OA application as needed.
6) Motivating intervention	- Goal setting for pre-post-surgery rehabilitation together and engagement during recovery - Introduction of older adults experienced healthy transition (VDO) - Offering appropriate information and emotional support - Provide encouragement and advice via Line OA private chat.
7) follow-up and monitoring	- Telephone or video call visit Via Line OA private chat after discharge. - Home visit - Via Line OA private chat after discharge.
8) Referral information and reports	- The word referral d/c information to the COC center via the COC link. - COC center referral to Health Promoting hospital in the community - The COC monitors and follows up on the site owner's response to the visit within 14 days after discharge.

Family caregivers were asked to send photos or videos via the app, of the patient's walking and rehabilitation progress during weeks three and five. Patients and family caregivers could review care materials and consult healthcare providers via Line OA platform at any time during home recovery. Following these interactions, information was recorded via the Continuity of Care (COC) link or the HOSxP (Hospital Information System). This helps management of patient data, medical records, and internal hospital systems across community health centers and regional hospitals for ongoing patient monitoring (Fig. 2).

Ethical considerations

Ethical approval was granted by the Social and Behavioral Sciences Institutional Review Board, Prince of Songkla University (Approval no. PSU IRB 2024-St-Nur 021(internal)) and the Research Ethics Committee of Songkhla Hospital (Approval no. SKH IRB 2024-Edu-On3-1086). All interventions were performed in accordance with relevant guidelines and regulations as the Declaration of Helsinki.

Approach to data collection

After receiving ethical approval, the researcher contacted head nurses in the orthopedic ward to ask permission for initially approaching the potential participants in person. Prior to data collection, each participant voluntarily provided written informed consent. Researchers explained the program to healthcare providers, and nursing

interventions were guided by a daily checklist and included Line OA components for healthcare providers to use and introduce to patients and families. Researchers and healthcare providers could follow and monitor the daily checklist, mark completed activities, and document pending tasks or those requiring handover to ensure that older adults and caregivers receive comprehensive knowledge and essential skills training, including the ability to comply with the program via Line OA. Before older adults are discharged from the hospital to home, clearly specify the dates for each visit according to the program and inform the older adult and their family.

After patient discharge, researchers and healthcare providers monitored patients' progression through regular communication, follow-up, reminders, and information provision. The scheduling of advanced home visits and supportive communication via private chat online OA or by smartphone video call with caregivers was performed to ensure consistent and complete delivery of the intervention.

Health outcomes were assessed in 16 families of older adults who underwent hip fracture surgery during implementation of the family-based transitional care program. Data on health outcomes were collected within a single group across three time points: hip function, activity of daily living, mobility function, and fear of falling, at time 1 (before discharge), time 2 (post-d/c 2 weeks), and time 3 (post-d/c six weeks). Feasibility of the program (adaptability, content, accessibility, acceptability, and satisfaction) was assessed by 16 families and 20 healthcare providers working in transitional care at the end of the program (six weeks post-discharge).

Instruments

The instruments were divided into two parts, including (1) Instruments for assessing health outcomes, and (2) Instruments for assessing the feasibility of the program.

Instruments for assessing health outcomes of the program

These included four parts: (1) the Demographic Data Questionnaire (DDQ), (2) Thai version of the Modified Harris Hip Score (TH-mHHS), (3) Thai version of the Barthel Index (TVBI), (4) Thai version of The Falls Efficacy Scale International (Thai FES-I), and (5) Time Up and Go (TUG).

Demographic Data Questionnaire (DDQ) The personal information questionnaire was developed by researchers for this study based on the literature review. It contains crucial personal data, divided into categories for patients, caregivers, and healthcare professionals. Patient and caregiver data include gender, age, education, occupation, income, underlying disease, patient's walking ability before the hip fracture, caregiver's relationship with the older adult, type of surgery, etc. Personal data for healthcare professionals includes gender, age, education, workplace department, and work experience.

Thai version of the Modified Harris Hip Score (TH-mHHS) [38] The original tool developed by Byrd and Jones [39] was translated and tested for the validity and reliability of the Thai version by Chumchuen and team [38]. It was adopted for assessing hip function with permission. There are eight items assessing the pain and function components; scores range from 0 to 100. The level interpretation is as follows: 90–100 denotes excellent, 80–89 indicates good, 70–79 is fair, 60–69 is poor, and below 60 is considered not passing [39, 40].

The Thai version of the Barthel Index (TVBI) [41] The original tool was developed by Mahoney and Barthel [42] to assess activities of daily living (ADLs). It was translated and the validity and reliability of the Thai version were tested by Laohaprasitiporn and team [41]. Ten physical functions were assessed, which are available for free and widely used in research and clinical settings. The evaluation is worth a full 20 points. The ability to carry out daily activities can be divided into three levels: Level 1 (0–4 points): unable to carry out daily activities. Level 2 (5–14 points): moderately able to carry out daily activities. Level 3 (15–20 points): able to carry out daily activities.

Time Up and Go (TUG) [43] The original tool was developed by Podsiadlo and Richardson [43] to assess mobility function, evaluate walking ability, and estimate the likelihood of falls among older adults when walking forward

three meters at a normal speed. The shorter the duration, the greater the improvements in mobility, balance, function, and walking ability, and the lower the risk of falling [33, 44].

Thai version of The Falls Efficacy Scale International (Thai FES-I) [45] This tool was developed within the Prevention of Falls Network Europe (ProFaNE) [46]. It has been translated and tested for validity and reliability into Thai (Thai FES-I) by Thiamwong [45]. The tool assesses fear or anxiety about falling across 16 activities, including both physical and social tasks, ranging from easy to difficult. The total score ranged from 16 to 64 points and interpreted into three levels: 16–21 points indicate no fear of falling, 22–27 points indicate a slight to moderate fear of falling, and 28–64 points indicate a high fear of falling [45, 47].

Instruments for assessing the feasibility of the program

The feasibility and satisfaction questionnaire was developed by researchers based on the literature review for this study. To assess the feasibility and satisfaction with a family-based transitional care program. There are six items assessing feasibility and six items assessing satisfaction with the program's use. The feasibility questions (Table 4) included adaptability (Nos. 1, 2, 6), content (Nos. 3, 4), and accessibility (No. 5). The possible responses for each item ranged from 1 (lowest), 2 (low), 3 (moderate), 4 (much), to 5 (very much). The average total program utilization score can be divided into five levels. 4.51–5.00: very high, 3.51–4.50: high, 2.51–3.50: moderate, 1.51–2.50: low, and less than 1.5: lowest.

Intervention fidelity and acceptability of the implementation of the program was also assessed through open ended questions, obtained via interviews with families and a group interview with healthcare providers working in intermediate care services. In this study, intervention fidelity was assessed regarding the design (such as theoretical framework, length of contact, number and duration of contact overtime) and training [48] (e.g., procedures for training, maintaining the daily activities, and documenting tasks overtime). The users' feedback and recommendations were also assessed at the end for adopting the program.

Validity and reliability of the instruments

The family-based transitional care program and all data collection instruments, including the TH-mHHS, TVBI, and Thai FES-I, were validated by three experts. The program was further refined based on expert feedback to ensure clinical relevance. The Scale-Content Validity Index (S-CVI) values for the TH-mHHS, TVBI, and Thai FES-I were all 1. The investigator conducted the pilot study to assess internal consistency of the TH-mHHS, TVBI, and Thai FES-I scale, the feasibility, and satisfaction questionnaires using Cronbach's alpha coefficient, yielding the values of 0.81, 0.87, 0.96, 0.83, and 0.85, respectively. Interrater reliability (IRR) for the Timed Up and Go (TUG) test was assessed between the researcher and a research assistant. When tested with the same patients, the results yielded an Intraclass Correlation Coefficient (ICC) of 0.99.

Data analysis

Data were analyzed using SPSS (Version 26). Participants' characteristics, feasibility, and satisfaction were analyzed using descriptive statistics, including frequencies and percentages, means, and standard deviations. A Repeated-Measures Analysis of Variance (RM-ANOVA) was used to compare the mean scores of these health outcomes within the group across the three time points. Before conducting the analysis, the data assumptions, including normality, were checked. This was assessed using Z-scores for skewness and kurtosis. It is useful for small samples ($n < 50$) and yields a ± 1.96 standard error at an alpha level of 0.05 [49]. Additionally, Mauchly's test of sphericity was performed, and the results indicated that the assumption was not violated (not significant). Adjustments were made when sphericity was violated. If the sphericity estimate was less than 0.75, apply the Greenhouse-Geisser correction. If it was greater than 0.75, use the Huynh-Feldt correction [50, 51].

The results indicated that the data were normally distributed, except for FES-I time 3 and TUG time 1. However, the results of normality tests in health and social sciences research often deviate from established norms. Evidence indicates that RM-ANOVA is generally robust to non-normality when the sphericity assumption is met [52]. The data assumptions were tested using Mauchly's test of sphericity. The results indicated that the assumption of hip function and activities of daily living was not violated. The data on mobility function and fear of falling violated the sphericity assumption; therefore, the researcher used the Greenhouse-Geisser correction to adjust the *p*-values [50, 51].

Results

Characteristics of the participants

The characteristics of participants were described (see additional file 1).

Older adults with hip fracture surgery

The study involved 16 older adult patients who underwent hip surgery for a fracture. Among the older adults, 11 (68.75%) were female, with a mean age of 73.63 years (SD=10.30). The majority (68.75%) had a primary school education. Regarding health status, most participants (87.25%) reported underlying health conditions, including diabetes (31.25%), hypertension (25%), dyslipidemia (12.5%), cardiovascular issues (12.5%), asthma (12.5%), anemia (12.5%), nerve compression (6.25%), and cataracts (6.25%). In terms of Body Mass Index (BMI), 56.25% of the older adults fell within the normal range (BMI=18.5–22.9), while 31.25% were classified as overweight (BMI=25–29.9). Before their injuries, most participants (62.50%) had walked independently, while 37.50% required a walking aid. The majority underwent Bipolar hemiarthroplasty surgery (50%), followed by Closed Reduction and Internal Fixation (CRIF) with Proximal Femoral Nail Antirotation (PFNA) (43.75%), and Total Hip Arthroplasty (THA) (6.25%). The waiting period for surgery was 48–72 h for 62.5% of participants, while 37.5% waited more than 72 h. Among older adults, 87.5% were not members of senior citizen clubs; however, 75% engaged in social activities regularly or occasionally before their injury.

Family caregivers

The majority of family primary caregivers were female (87.5%) and had a mean age of 47.88 years (SD=12.40). The familial relationships among the family caregivers varied: 43.75% were parent-child pairs, 25% were grandchildren, 12.5% were spouses, 12.5% were siblings, and 6.25% were other relationships. Furthermore, 81.25% of family caregivers lived in the same household as the older adults they cared for, while 18.75% resided in the same neighborhood. Most family caregivers held a bachelor's degree (37.5%), while others had completed high school or vocational training (25%). In terms of occupation, 37.5% worked as general employees, 25% were company employees, 25% were traders or owned private businesses, and 12.5% were agriculturists. Half of the caregivers reported a monthly income in the range of 5,000 to 10,000 baht. Most family caregivers did not have any underlying health issues, accounting for 75% of the group. Additionally, 81.25% had previous experience in caring for patients, either in a hospital setting or at home. Most caregivers (81.25%) were aware of community resources available to them, and all families had additional caregivers to assist when needed.

Health care providers

Twenty registered nurses evaluated the program's feasibility and satisfaction. Eighteen participants (90%) were female. Twelve Nurses (60%) worked in orthopedic wards, while eight of them (40%) were community nurses.

The mean age of the participants was 32.55 years (SD 9.54), ranging from 24 to 54 years. 18 participants held bachelor's degrees, except two held master's degrees. The work experience was 9.5 years (SD 8.89), ranging from 1 to 32 years.

Recruitment and retention rate

Of the 17 eligible families of older adults with hip fractures, one family (5.88%) declined to participate in the discharge because there was no responsible primary caregiver, and the family refused to participate in the program. Therefore, 16 individuals willingly participated, representing a recruitment rate of 94.12%. All 16 participants completed the entire program, representing a 100% retention rate.

The Line OA access rate among patients or their families was 100%, with daily access occurring 1–2 times per day during their hospital stay. After discharge, usage was 100% in the first week and 80.25%, 75%, 100%, 68.75%, and 75% in weeks 2–6, respectively. Frequently used menus included Care Videos for Patients and Caregivers, Frequently Asked Questions, Health Consultation Channels, video or phone calls, and private chat. In addition, all family caregivers were able to adhere to the program under the researcher and healthcare professional support via Line OA, home visits.

Health outcomes

The preliminary effectiveness of health outcomes showed significant improvements over time across all measures. These were hip function period ($F=254.72$, partial Eta-squared = 0.94, $p = .00$), the activity of daily life ($F=230.55$, partial Eta-squared = 0.93, $p = .00$), mobility function ($F=159.63$, partial Eta-squared = 0.91, $p = .00$), and fear of falling ($F=155.68$, partial eta-squared = 0.88, $p = .00$) (Table 2), and Post hoc analyses confirmed these significant differences across all three time points. (see additional file 2) The means of health outcomes comparisons at three time points are shown in Table 3.

Completion rate

Considering individual pre- and post-program health outcomes, all older adults ($N=16$) showed improvement across all outcomes, representing a 100% completion rate. At the end of the program, hip function improved by an average of 41.25% (Min 30.80, Max 53.90), with 13 participants (81.25%) at the fair level and 3 (18.75%) at the good level. The activity of daily life improved by an average of 38.75% (Min 20, Max 55), all participants are

Table 2 Comparison of health outcomes across time, within groups ($N=16$)

Sources of variance	Sum of square	df	Mean square	F	Partial Eta-Squared	Sig.
Hip function						
Time	13649.25	2	6824.62	254.72	0.94	0.00
Error	803.793	30	26.793			
Activity of daily life						
Time	498.86	2	249.44	230.55	0.93	0.00
Error	32.458	30	1.082			
Mobility function						
Time	471486.17	1.35	348854.22	159.63*	0.91	0.00
Error	44303.83	30	1476.79			
Fear of falling						
Time	6060.79	1.29	4697.15	115.68*	0.88	0.00
Error	785.86	19.36	40.604			

RM-ANOVA test is significant at $\alpha=0.05$

* Greenhouse-Geisser correction was used to reduce type error

Table 3 Comparisons of the mean of health outcomes at three time points ($N=16$)

Health Outcomes	Time	Mean	SD	95% Confidence Interval		MD	Sig
				Lower	Upper		
Hip function	1.Before D/C	34.92	3.78	32.91	36.93	41.26	0.00
	2.After D/C 2 wks.	53.70	6.45	50.25	57.13		
	3.After D/C 6 wks.	76.18	5.46	73.26	79.08		
Activity of daily life	1.Before D/C	11.25	1.61	10.39	12.10	7.75	0.00
	2.After D/C 2 wks.	16.44	1.82	15.46	17.41		
	3.After D/C 6 wks.	19.00	1.37	18.27	19.72		
Mobility function	1.Before D/C	274.56	59.42	249.90	306.22	228.37	0.00*
	2.After D/C 2 wks.	89.06	41.18	67.12	111.00		
	3.After D/C 6 wks.	46.19	19.14	35.99	56.38		
Fear of falling	1.Before D/C	58.19	9.07	53.35	63.02	27.19	0.00*
	2.After D/C 2 wks.	40.88	6.65	37.33	44.20		
	3.After D/C 6 wks.	31.00	5.59	28.02	33.97		

RM-ANOVA test is significant at $\alpha=0.05$

MD Mean Difference

* Greenhouse-Geisser correction was used to reduce type error

at a level where they can help themselves. The mobility function improved by an average of 82.10% (Min 73.33, Max 96.00), all participants were able to walk independently or use walking aids again. Fear of falling improved by an average of 56.64% (Min 25.00, Max 70.88). All participants showed a decrease in their fear-of-falling scores; however, most scores still indicated a high level of fear of falling.

The feasibility of the program

The feasibility of the Family-Based Transitional Care Program, including adaptability, content, accessibility, acceptability, and satisfaction, was evaluated by all participants.

Feasibility (adaptability, content, accessibility)

Based on the combined average feasibility scores, families scored higher than healthcare providers. Families' score was at a very high level (4.82, SD 0.21), while healthcare providers' score was at a high level (4.39, SD 0.42) (Table 4).

The families rated the program's feasibility question for all six items at a very high level, indicating that the program was adaptable, presented appropriately in the correct situation, convenient and easy to implement, and, overall, appropriate and implementable in practice. The content of the program was clear and comprehensive, and the program's effectiveness improves health outcomes. They also reflected that the program could expand access to information for older adults and their families, enabling them to continually learn and feel confidence about caring for older adults at home.

Healthcare providers rated the program's feasibility average score as high level. Across all aspects, Adaptability and Content were rated at a high level. However, Accessibility was rated at a very high level. In addition, implementation fidelity was reflected in discussions within the healthcare workers' group, indicating that managing home visits one week after discharge can be challenging in practice. Due to the workload and the limited number of healthcare personnel, it was difficult to visit every patient as planned.

Table 4 The feasibility of the family-based transitional care program (Healthcare provider; HCP=20, Families $N=16$)

No.	Items of Feasibility	Mean (SD)			
		HCP ($N=20$)	Level	Families ($N=16$)	Level
1.	The program is appropriate in the real situation in the context of Songkhla Hospital.	4.20 (0.53)	high	4.81 (0.40)	Very high
2.	The program is convenient and easy to implement.	4.25 (0.64)	high	4.81 (0.40)	Very high
3.	The format and content of the program are clear and comprehensive.	4.40 (0.50)	high	4.81 (0.40)	Very high
4.	The effectiveness of the program improves health outcomes (hip function, ability to perform daily activities, ability to move, and reduced fear of falling).	4.40 (0.50)	high	4.88 (0.34)	Very high
5.	The program can increase access to information for older adults and their families, allowing them to continuously learn about caring for them after hip fracture surgery.	4.60 (0.60)	Very high	4.63 (0.50)	Very high
6.	Overall, the program is appropriate and can be implemented in practice.	4.50 (0.69)	high	5 (0.00)	Very high
	Average score	4.39 (0.42)	high	4.82 (0.21)	Very high

Table 5 The satisfaction of the family-based transitional care program (Healthcare provider; HCP=20, Families $N=16$)

No	Items of satisfaction	Mean (SD)			
		HCP ($N=20$)	Level	Families ($N=16$)	Level
1.	The program is appropriate for older adults and their families.	4.10 (0.55)	high	4.94 (0.25)	Very high
2.	The program is convenient and easy for older adults and/or their families.	4.40 (0.68)	high	4.81 (0.40)	Very high
3.	The program helps older adults and their families continuously access knowledge on caring for older adults after hip fracture surgery.	4.30 (0.73)	high	4.88 (0.34)	Very high
4.	The program helps older adults with hip fracture surgery recover well.	4.35 (0.59)	high	4.88 (0.34)	Very high
5.	Overall, the program is helpful for older adults and their families.	4.70 (0.66)	Very high	4.69 (0.48)	Very high
6.	Overall satisfaction with the program.	4.50 (0.69)	high	4.94 (0.25)	Very high
	Average scores	4.39 (0.50)	high	4.86 (0.16)	Very high

Satisfaction

Considering the combined satisfaction average scores of healthcare providers ($N=20$) and families ($N=16$), families scored higher than healthcare providers. Families' scores were higher (4.86, SD 0.16) than healthcare providers' scores (4.39, SD 0.50). (Table 5)

The family's satisfaction with the program across all six items is very high, indicating that the program is appropriate for older adults and their families, convenient, and easy. It helps that they can continuously access knowledge about caring, which supports older adults with hip fracture surgery in recovering well, and overall satisfaction with the program is high.

Healthcare providers perceive the program's satisfaction as one of six items at the very high level, including item 5, which states that the program is helpful. Other items, such as the program being appropriate in the context, convenient and easy to use, clear format and content, and the program's effectiveness and overall satisfaction, were evaluated at a high level.

Acceptability

The family-based transitional care program was accepted by healthcare providers, patients, and their family caregivers. However, the program was modified in two topics to be more flexible and better suited to real-world situations, informed by participant feedback and recommendations.

First, schedule for home visits during the first week after discharge; adjusting the home visit schedule from week one to week two after discharge (with no high-risk group) and home visits in week one after discharge only in the high-risk group (including patients with unsuitable home environments, risk of wounds or urinary tract infections, reduced mobility, and limitations in family caregiving, such as being left alone during the day). Due to the workload and limited healthcare personnel, it was difficult to visit every patient. However, healthcare providers-maintained video calls or phone visits in week one after discharge.

Second, some family caregivers lacked sufficient time or limited understanding to learn all the educational materials while caring for patients in the hospital. Health education components were revised to fit with the caregiver's context by selecting essential educational materials tailored to the patient's daily needs. Additionally, supplementary materials are provided to family caregivers via the Line OA application at their convenience for further learning. The researcher also provided guidance, reminders, and tracking, and sent links via the private chat channel in the Line OA application. Mark the critical and necessary educational materials in the daily nursing care guidelines with an asterisk to indicate what should be taught and concern for those being discharged.

Discussion

The result of preliminary effectiveness of health outcomes of hip function, activities of daily living, mobility function, and fear of falling of older adults following hip fracture surgery, when comparing to before discharge, two weeks, and six weeks after discharge, showed significant differences in the mean scores of all health outcomes across time. This shows the program's effect, demonstrating continuous improvement in health outcomes among older adults who underwent hip fracture surgery. The program was developed based on transition theory, integrated with family-based illness care, encompassing a wide range of conditions and services to ensure continuity of care and prevent adverse effects for vulnerable individuals who may experience changes in care settings or caregivers [30]. It has been implemented in discharge planning to prepare older patients and their family caregivers for the transition from hospital to home. The concept of family-centered illness care emphasizes the critical role that families play in supporting ill members during this transition [31].

The program in this study primarily uses nursing therapeutics to care for patients and family caregivers, including: the first is an assessment of the readiness of older patients and families to transition home. This includes identifying problems and needs and collaboratively setting care and rehabilitation goals. The second part focuses on preparing for the transition. This involves providing health education, skills training, and making necessary adjustments to create a safe home environment before discharge. The third part, known as role supplementation, emphasizes promotion, prevention, and intervention to support older patients and families as they transition smoothly to their new circumstances [30]. These activities span from hospitalization to ongoing home care.

Integrating Line OA into the program has contributed to "better" recovery compared with standard care by supporting participants' transitions and improving health outcomes. The six main features of the application are: (1) Motivating Videos, (2) Care Videos for Patients and Caregivers, (3) Frequently Asked Questions, (4) Locating Nearby Social Care and Assistance Centers, (5) Video Downloads, and (6) Health Consultation Channels. It closes the gap in barriers to context, serving as a teaching and learning tool, a platform for knowledge review, a communication and consultation channel, a resource for information about the community resource center, and an online monitoring and follow-up channel after discharge. In addition, Line OA is convenient, accessible, and familiar to caregivers who use it daily. The media content, consisting of easy-to-understand, concise videos and images, empowers caregivers with the knowledge, skills, and confidence to care for patients at home, offering

encouragement and helping prevent feelings of isolation as they face these changes. Overall, it enhances patients' and family caregivers' preparedness and ability to support good recovery and improved health outcomes in transitional care.

This study's findings on the family-based transitional care program were used to test its feasibility among families (older adults and their family caregivers). The preliminary effectiveness analysis found significant improvement in all health outcomes, including hip function, activities of daily living, mobility function, and fear of falling throughout the recovery process. The results are consistent with previous research by Ko and team [33], which found that the Transitional Care Program for older adults who have undergone hip arthroplasty includes nursing interventions over six weeks. This program can feasibly improve health outcomes, reduce functional decline, enhance activities of daily living, increase mobility as measured by the Timed Up and Go test, and decrease fear of falling. This is like the previous study conducted by Mashhadi-Naser and team [35] on a family-based care transition program includes education, training, rehabilitation, stress management, and the use of social media to enhance social connections. Interventions delivered within four weeks of discharge resulted in a significant increase in participants' activities of daily living and health-related quality of life. In addition, the components of this program also focused on enhancing individual and family self-management which prepare them well with procedure training for postoperative care of hip fracture. The retention rate with program was high with professional support which enable them to implement at home.

Moreover, supportive environment by using technology in transitional care for patients with hip fracture surgery can lead to positive health outcomes. It is designed based on previous evidence that digital health technology can enhance communication between patients and healthcare providers and recommended to use twice as part of standard care [53]. Additionally, a meta-analysis of randomized controlled trials examining the effects of telerehabilitation on postoperative outcomes in patients with hip fractures found that those in the telerehabilitation group showed significant improvements in hip function, as measured by the Harris Hip Score. There were also notable gains in functional independence, adherence to rehabilitation, and overall quality of life [54]. It is beneficial to involve tele-rehabilitation programs via home visits and mobile application linked to a healthcare provider's webpage for follow-up, to speed up recovery after discharge. However, the satisfaction score among healthcare providers gave lower ratings. This may be because the program increased the nursing workload when required number of home visits and coordination challenges after discharge. Understanding the providers' perspective is crucial for the program's successful integration into existing hospital systems.

The program's strengths that contribute to trends of improved health outcomes for older adults following hip fracture surgery include a multifaceted approach that supports physical, psychological, and social dimensions. A distinct novelty is the use of a mobile application designed to support patients and their family caregivers, helping them increase readiness for the transition period. However, these improved outcomes may not be solely due to the program itself, as the results could be influenced by several factors which may influence recovery after hip fracture surgery. These factors include fracture severity, surgical procedure, rehabilitation intensity, comorbidities, caregiver characteristics, and social support. These confounding factors were not adjusted for the analysis which could affect the observed outcomes. It requires adoption, replication and test the effectiveness in the future study.

Limitations and recommendations

Some limitations of this study are addressed. First, the study employed a single-group experimental design without a control group, which reduces its reliability. The sample size was relatively small, although it met statistical requirements. For future research, quasi-experimental or randomized controlled trials (RCTs) comparing two groups, including larger sample size and longer follow-up period (e.g., 3 to 6 months) are recommended. This would allow evaluation of the long-term sustainability of family caregiving behaviors and their impact on hospital readmission rates. Second, the study included only older adults who had undergone surgery and had no cognitive impairment or depression and did not cover patients with severe chronic illness or vulnerable groups which may limit external validity and generalizability. Therefore, future studies should include patients in vulnerable

groups, and relevant professionals may be involved, such as social workers, psychologists, psychotherapists, and occupational therapists. Third, access to the internet and the local language is essential for fully understanding and using the application. So, in practice, one should prepare alternative strategies for patients to limit access to technology, such as a booklet, or strictly refer to information and coordinate with community health center staff or local organizations. Finally, this study did not assess caregiver outcomes. Therefore, some related factors such as caregiver burden, caregiving self-efficacy, preparedness, competence, or quality of life should be included in future studies.

Conclusions

A family-based transitional care program was developed to bridge the gap in transitional care for older adults who have undergone hip fracture surgery. This program uses a mobile application to assist healthcare providers and families in preparing for transitional care before patient discharge. Patients, family caregivers, and healthcare providers need to work collaboratively. To equip families with the necessary information, skills training, and counseling to enhance their confidence in providing home care. Meanwhile, patients and family caregivers must work together in the caregiving process, follow recommendations to support rehabilitation, and avoid risk factors that could lead to complications. This collaborative effort ultimately empowers families to achieve a good transition. The program was feasible and acceptable to patients, their families, and healthcare providers. In addition, health outcomes showed a trend towards improvement. However, the effectiveness of these outcomes should be confirmed through adequately powered randomized controlled trials.

Abbreviations

BMI	Body Mass Index
COC	Continuity of Care
CRIF	Closed Reduction and Internal Fixation with
CVI	Content validity index
DDQ	Demographic Data Questionnaire
HCP	Healthcare provider
ICC	Intraclass Correlation Coefficient
IMC	Intermedia Care
IRR	Interrater Reliability
Line OA	Line Official Account
MD	Mean Difference
PFNA	Proximal Femoral Nail Antirotation
RM-ANOVA	Repeated-Measures Analysis of Variance
SD	Standard Deviation
THA	Total Hip Arthroplasty
Thai FES-I	Thai version of The Falls Efficacy Scale International
TH-mHHS	Thai version of the Modified Harris Hip Score
TUG	Time Up and Go
TVBI	Thai version of the Barthel Index

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Data availability The research data are not publicly available due to privacy and ethical restrictions (participant consent forms. The raw de-identified data may be made available upon reasonable request from the corresponding authors.

Declarations

Ethics approval and consent to participate This study was conducted after obtaining approval from the Social and Behavioral Sciences Institutional Review Board, Prince of Songkla University (Approval no. PSU IRB 2024-St-Nur 021(internal)) and the Research Ethics Committee of Songkhla Hospital (Approval no. SKH IRB 2024-Edu-On3-1086). All participants were introduced and approached after permission to contact via head nurses in the orthopedic ward. The researcher provided the participant with a thorough explanation of the study's goals, methodology, potential advantages, and foreseeable risks. Their participation was voluntary, and they were free to refuse without penalty or any consequences for their healthcare services and welfare.

Consent for publication Not applicable.

Competing interests The authors declare no competing interests.

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