


# Comparison of Highly Intensive Home-Based Post-acute Care to Inpatient Program for Patients With Fragility Fractures After Surgery

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## Abstract

**Introduction:** Evidence suggests that patients with fragility fractures would benefit from post-acute care (PAC); however, they have been subjected to varying PAC programs. This study aimed to compare the effectiveness of home-based PAC (HPAC) to inpatient PAC (IPAC) programs for patients with fragility fractures in Taiwan. **Materials and methods:** This is a retrospective study that reviewed the medical records of patients who received HPAC or IPAC within three weeks after hip, knee, or spine fragility fractures in the Taipei City Hospital from September 1, 2017, to August 31, 2018. **Results:** The mean age ( $78.9 \pm 10.8$  years) showed significant difference between the HPAC (age =  $80.6 \pm 11.1$ ,  $n = 83$ ) and the IPAC (age =  $78.2 \pm 10.6$ ,  $n = 185$ ) groups ( $P = .049$ ). After PAC, both HPAC and IPAC groups showed improvement on Barthel index, numerical pain rating scale, and Harris hip score (all  $P < .001$ ). Patients in the HPAC group displayed greater improvement than the IPAC group on Barthel Index for activities of daily living (ADLs) by 5.8 (95% confidence interval, 3.0 to 8.5). The IPAC group had a significant longer length of PAC than the HPAC group ( $12.4 \pm 3.0$  vs.  $11.1 \pm 2.7$ ,  $P < .001$ ). **Conclusion:** Both PAC programs could significantly improve functional performance and reduce pain in patients with fragility fractures. Patients treated in the HPAC group had better ADLs, and less length of PAC.

## Keywords

fracture, home-based post-acute care, inpatient post-acute care, activities of daily living

## Introduction

The population of Taiwan is aging similar to world trends. Taiwan is predicted to become a super-aged society soon, which means 20% of the population will comprise elderly people ( $\geq 65$  years).<sup>1</sup> As people getting older, the risk of fragility fracture increases, and common affected site including spine, hip, wrist, and pelvis.<sup>2</sup> This causes disability as well as high mortality.<sup>3-5</sup> With the improvement in medical care, diagnosis-related group (DRG)-based reimbursement systems have led to shorter hospital stays. However, patients with fragility fractures often experience

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pain, disability, and barriers after discharge. Thus, there is an urgent need to develop post-acute care (PAC) programs to enable these patients to regain their health.

The PAC program is intended to help patients discharged from hospital after acute care to return home successfully, live independently, and restore their function by providing them continuous care and rehabilitation.<sup>6</sup> Common PAC providers include inpatient rehabilitation facilities, home health agencies, and skilled nursing facilities.<sup>7</sup> In previous studies, patients who received home-based PAC (HPAC) or inpatient PAC (IPAC) could significantly improve their ambulation performances, and activities of daily living (ADLs).<sup>8,9</sup> However, some studies reported that patients in the home-based group had better outcomes in functional recovery and balance confidence than those in the inpatient group.<sup>10-13</sup> Compared with inpatient rehabilitation, home-based rehabilitation has lower risks of complications and readmissions after joint replacement.<sup>14</sup> In contrast, Seitz, et al. found that, compared with the control group, the rates of using long-term care were lower in the HPAC group, but of mortality were lower in the IPAC group.<sup>15</sup> Therefore, both the HPAC and the IPAC programs would be an important factor for recovery after an orthopedic surgery.

After being discharged from the acute care, however, it was rare for patients in Taiwan to receive any kind of PAC. Therefore, patients may need further long-term care.<sup>13</sup> Since July 2017, the National Health Insurance Administration in Taiwan has launched HPAC and IPAC projects for fragility fracture patients, providing within three weeks care services in order to help patients recovery, reduce medical cost, and release the burden on patients' families.<sup>16</sup>

The purpose of this study was to compare the effectiveness of the HPAC to the IPAC programs for patients with fragility fractures in Taiwan.

## Methods

### Study Design

This is a retrospective study to investigate the effectiveness of the HPAC and the IPAC by reviewing the medical records of patients who received PAC for hip, knee, or spine fragility fracture in Taipei City Hospital from September 1, 2017, to August 31, 2018. Patients with hip fractures were admitted with the *International Classification of Disease, Tenth Revision* (ICD-10) coding S72.0, S72.1, or S72.2. For patients with knee fractures were admitted with ICD-10 coding S72.4, S82.0, S82.1, or S89.2. For patients with spine fractures were admitted with ICD-10 coding S12, S22, or S32. All types of fractures, such as unstable fractures, were included in this study. The definition of the fragility fracture was known as falling from standing height. Patients with hip fractures were received with hemiarthroplasty or open reduction with internal fixation (ORIF). Patients with knee or spine fractures

were treated with ORIF. The study was approved by the Research Ethics Committee of the Taipei City Hospital.

Patients who met the following criteria were enrolled in this study:<sup>16</sup> (1) fragility fracture suffered due to functional decline within one month after surgery and the Barthel Index between 40 and 70; (2) stable medical condition and no major complications; (3) rehabilitation potential; and (4) aged  $\geq 50$  years.

Patients were excluded if they met the following criteria: (1) spinal fracture with spinal cord injury; (2) severe mental or cognitive impairments; (3) long-term ventilation-dependence; (5) terminal status; (6) long-term bed-ridden; (7) patients with cancer who need continued inpatient care.

### PAC Program

Before being discharged, all patients were assigned to the HPAC program or the IPAC program based on the decision of the discharge planning. If patients and their families agreed to participate in the PAC program at their home, they were enrolled in the HPAC program. However, if patients and their families agreed to participate in the PAC program but did not get ready to go home after discharge from the orthopedic unit, they were admitted to the IPAC program.

Patients in the HPAC group were visited two to three times weekly by a well-trained physical therapist or occupational therapist of the Taipei City Hospital depending on the evaluation within three weeks. The content of home program mainly focused on restoring functional performances, helping patients deal with daily activities at home, and making the program fit in their daily lives. Patients were followed up by their orthopedic surgeons at outpatient clinics at least once during the HPAC period.

Patients in the IPAC group received daily care from their rehabilitation team including a physician, nurse, physical therapist, and occupational therapist. Physical or occupational therapy was provided once or twice daily during weekdays within the three weeks.

In the two groups, the physical therapy program emphasized on post-operative exercises, including hip range of motion exercise, muscle strengthening, functional activity facilitating, and indoor ambulation training. The occupational therapist focused mainly on independence in basic and instrumental ADLs. Furthermore, therapists modified home environments for patients in the HPAC group to reduce the risk of falling.

### Baseline Assessment

Information including age, sex, level of education, affected joint, types of operation, post-operative complications, number of comorbidities, home environment, and length of acute hospital and PAC stay were collected from medical records.

## Outcome Measurements

The outcome measurements of all patients were assessed before and after the PAC program using the Barthel Index, numerical pain rating scale, and Harris hip score.

The Barthel Index is widely known as a measurement of ADLs for geriatric patients. It consists of self-care skills; such as feeding, grooming, bathing, dressing, bowels, bladder, and toilet use; and mobility skills like transfers between bed and chair, ambulation on level surfaces, and stairs. The score of the Barthel Index is from 0 (total dependence) to 100 (total independence) which depends on how much the assistance patients need.<sup>17</sup> The disable severity was classified as 0–20 (total dependence), 21–60 (severe dependence), 61–90 (moderate dependence), and 91–99 (slight dependence).<sup>18</sup>

The pain of the affected site after fractures was assessed by using the numerical pain rating scale ranging from 0 (no pain) to 10 (worst possible pain).<sup>19</sup>

The Harris hip score is tended to assess the results of hip surgery for patients with femoral neck fractures. There are four domains including pain, function, joint deformity, and range of motion which were evaluated by physical therapists. The score of the Harris<sup>20</sup> hip score between 0 and 100 graded as <70 (poor), 70–79 (fair), 80–89 (good), and 90–100 (excellent).

Besides, readmission rates and emergency visits within 30 days were documented after discharging from the PAC program.

## Statistical Analysis

SPSS version 20 (IBM SPSS Statistics, IBM Corporation, Chicago, IL) was used for statistical analysis. Continuous variables were presented as mean  $\pm$  standard deviation, and categorical variables were presented as percentages or times. Due to the nonnormal distribution of the data, the Mann–Whitney *U* test was used to analyze the differences between the two groups. A chi-square test was computed to compare differences in proportion. To evaluate the differences of the improvements on the Barthel Index, pain, and Harris hip score between two groups after PAC, multivariate linear regression analysis was used. Variables that differed between two groups at baseline ( $P < .05$ ) or that affected the recovery for patients with hip fractures were included for adjustment in the multivariate linear regression analysis. For all tests, a  $P$ -value  $< .05$  was set as the level of significance using a two-tailed test.

## Results

A total of 268 patients (mean age  $78.9 \pm 10.8$  years) were enrolled in this study; 159 (59.3%) of the patients were women. Most of them (92.2%) suffered from hip fractures. Of all patients, 83 (31.0%) underwent the HPAC program,

and 185 (69.0%) underwent the IPAC program. Except that older ( $80.6 \pm 11.1$  vs.  $78.2 \pm 10.6$ ,  $P = .049$ ) and shorter length of PAC ( $11.1 \pm 2.7$  vs.  $12.4 \pm 3.0$ ,  $P < .001$ ) in the HPAC group than in the IPAC group, no significant differences were found in most clinical demographics between groups (see Table 1).

As shown in Table 2, patients in both groups displayed significant improvement on Barthel Index, pain intensity, and Harris hip score after the PAC programs ( $P < .001$ ). Furthermore, patients in the HPAC group showed significantly greater improvement on Barthel Index than those in the IPAC group ( $14.5 \pm 11.7$  vs.  $10.4 \pm 10.3$ ,  $P = .015$ ), but improvement rates in pain intensity ( $-2.5 \pm 2.2$  vs.  $-2.7 \pm 1.5$ ,  $P = .219$ ) and Harris hip score ( $14.0 \pm 13.8$  vs.  $17.8 \pm 13.8$ ,  $P = .065$ ) were similar in both groups. The variables included group, age, acute hospital stay, length of PAC, types of operation, post-operative complication, comorbidities, and baseline Barthel Index score were adjusted for multivariate linear regression analysis. The analysis found that the mean difference of the improvement in the Barthel Index was 5.8 (95% CI, 3.0 to 8.5,  $P < .001$ ) which favors the HPAC group. However, no significant differences were found for the pain score (.1; 95% CI,  $-.4$  to  $.6$ ,  $P = .686$ ) and Harris hip score ( $-.2$ ; 95% CI,  $-4.1$  to  $3.6$ ,  $P = .901$ ).

Table 3 shows proportions of improvements in the subcategories of Barthel Index after PAC between groups. The HPAC group had higher improvements in dressing (16.4% vs. 8.1%,  $P = .049$ ), transfer (76.7% vs. 46.5%,  $P < .001$ ), and stairs (37.0% vs. 7.6%,  $P < .001$ ) than the IPAC group.

Comparisons of the 30-day readmission rates showed that the HPAC group (4.8%) had lower readmission rates than the IPAC group (8.1%), but this difference was not statistically significant ( $P = .444$ ). The HPAC group (8.4%) also had less emergency visits than the IPAC group (9.7%), yet this difference was still insignificant ( $P = .824$ ).

## Discussion

The present study is the first study to investigate the effectiveness of the short-period and high intensive both home-based and hospital-based PAC program for patients with fragility fractures after discharging from index hospitalization in Taiwan. In our study, similar baseline characteristics were found in both groups regarding affected joint, types of operation, the number of comorbidities, as well as the disable severity at PAC admission. We observed that both the HPAC and the IPAC program could significantly restore patients' functional performances and reduce post-operative pain. Furthermore, patients in the HPAC group showed greater functional independence within a shorter duration of PAC than those in the IPAC group. Also, patients in the HPAC group had lower 30-day readmission rates and emergency visits after PAC programs.

**Table 1.** Demographic and clinical characteristics of patients in different post-acute care (PAC) programs.

	Home-Based PAC (n = 83)	Inpatient PAC (n = 185)	P value
Age, mean $\pm$ SD (y)	80.6 $\pm$ 11.1	78.2 $\pm$ 10.6	.049
Sex (female), n (%)	48 (57.8%)	111 (60.0%)	.738
Education ( $\geq$ 6 years), n (%)	65 (78.3%)	137 (74.1%)	.454
Fracture joint, n (%)			.294
Hip	74 (89.2%)	173 (93.5%)	
Knee	7 (8.4%)	7 (3.8%)	
Spine	2 (2.4%)	5 (2.7%)	
Types of operation, n (%)			.935
Hemiarthroplasty	35 (42.2%)	79 (42.7%)	
Open reduction internal fixation	48 (57.8%)	106 (57.3%)	
Post-operative complication (yes), n (%)	8 (9.6%)	20 (10.8%)	.937
Number of comorbidities, n (%)			.209
0	7 (8.4%)	12 (6.5%)	
1–3	57 (68.7%)	111 (60.0%)	
>3	19 (22.9%)	62 (33.5%)	
Home environment, n (%)			.080
1F	17 (20.5%)	58 (31%)	
Above 2F	66 (79.5%)	130 (69%)	
Acute hospital stay, mean $\pm$ SD (day)	8.9 $\pm$ 4.7	8.1 $\pm$ 4.7	.157
Length of PAC, mean $\pm$ SD (day)	11.1 $\pm$ 2.7	12.4 $\pm$ 3.0	<.001

SD, standard deviation

**Table 2.** Outcome comparison before and after post-acute care (PAC).

	Home-Based PAC (n = 83)			Inpatient PAC (n = 185)		
	Before	After	Difference	Before	After	Difference
Barthel Index	48.9 $\pm$ 8.9*	63.4 $\pm$ 14.8*	14.5 $\pm$ 11.7**†	45.4 $\pm$ 8.0*	55.8 $\pm$ 13.8*	10.4 $\pm$ 10.3*,†
Numerical pain rating scale	5.4 $\pm$ 2.0	2.9 $\pm$ 1.9	–2.5 $\pm$ 2.2†	5.3 $\pm$ 1.7	2.5 $\pm$ 1.7	–2.7 $\pm$ 1.5†
Harris hip score (only for hip fracture)	42.6 $\pm$ 13.7	56.6 $\pm$ 13.7	14.0 $\pm$ 13.8†	41.7 $\pm$ 15.5	59.5 $\pm$ 15.5	17.8 $\pm$ 13.8†

NOTE. Values are mean  $\pm$  SD.\*Comparison between two groups ( $P < .05$ ).†Comparison with previous assessment ( $P < .001$ ).**Table 3.** Improvements of subcategories in Barthel Index after PAC.

	Home-Based PAC (n = 83)	Inpatient PAC (n = 185)	P value
Feeding	12 (16.4%)	35 (18.9%)	.642
Grooming	11 (15.1%)	30 (16.2%)	.820
Bathing	4 (5.5%)	8 (4.3%)	.745
Dressing	12 (16.4%)	15 (8.1%)	.049
Bowels	10 (13.7%)	35 (18.9%)	.320
Bladder	13 (17.8%)	18 (9.7%)	.072
Toilet use	30 (41.1%)	54 (29.2%)	.066
Transfer	56 (76.7%)	86 (46.5%)	<.001
Ambulation	36 (49.3%)	103 (55.7%)	.356
Stairs	27 (37.0%)	14 (7.6%)	<.001

In this study, over 90% of patients suffered from a hip fracture. However, a previous report investigating the incidences of osteoporosis-related fractures in the US found that hip fractures only comprised 14% of the total distribution.<sup>2</sup> The reason for this discrepancy may result from the inclusion criteria of the present PAC program. Only those patients underwent surgery with fixation or arthroplasty would be recruited in this program.<sup>16</sup> Therefore, those patients with spinal fragility fractures who underwent vertebroplasty would not be included.

Consistent with the results of previous studies,<sup>11,13,21</sup> patients with fragility fractures who underwent the HPAC program had better ADLs recovery in the Barthel Index than those of other PAC programs at three to four months after discharge. In the present study, we noticed that it could be recognized at two weeks after discharge. Besides, we found that the patients in the HPAC program could learn how to manage their post-operative pain as those in the IPAC program. Previous studies revealed that patients who underwent home-based intervention could significantly decrease their pain in both short-term and long-term.<sup>22,23</sup> Also, for patients with hip fractures in our study, the improvement in hip function was similar in both PAC groups. However, the results of the present study and previous ones cannot be comparable since the differences of time duration for PAC programs. The previous ones maximum duration was set for from 3 to 12 weeks with lower home visit intensity.<sup>11,13,22,24</sup> Our study reveals that a highly intensive, short-term, home-based intervention is a novel management procedure for these populations after they have been discharged from acute care.

Patients in the HPAC had a higher proportion of improvements in dressing, transfer, and stairs than those in the IPAC. The possible reasons are that home-based interventions could provide more tailor-made programs according to the patient's familiar living environment with task-oriented training.<sup>25</sup> In addition, patients in the HPAC may have more practice in these ADLs with families at home while those in the IPAC may have less practice due to electric bed and elevator in hospitals. Rehabilitation at the patient's home can increase their confidence and promote functional recovery that led to better outcomes.<sup>12,21,24</sup> Although, there was only one item difference in the scoring of activities for the Barthel Index, it indicated that the HPAC could be an alternative option. Furthermore, the duration of the HPAC was shorter than the IPAC, which implied the medical expenditure may be less in the HPAC than the IPAC.<sup>8</sup>

There were some limitations to this study. First, the present study was not a randomized controlled trial, and there was no control group to compare with the PAC programs. Every patient discharged from acute care would receive good transitional care to the PAC programs by the patient's intention or family support. However, their decision may be affected by home environmental settings and

families' readiness which were not known in our study. Another limitation was that we only evaluated patients before and after the PAC programs, without long-term follow-up. Therefore, a long-term follow-up is recommended for future studies. Also, although different surgical methods and materials performed by different surgeons may affect patients' recovery, detailed surgical information was not available in this study. Additionally, the venue for the evaluation was different for the two groups; patients' houses for the HPAC, and hospitals for the IPAC. However, the ultimate goal of PAC is to help patients return home and to their previous lifestyle successfully. Therefore, we suggest an evaluation and programming design that would be closer to reality to the patient's home than in the hospitals.

## Conclusion

A highly intensive and short-term PAC program could significantly improve functional performances and reduce pain in patients with fragility fractures. Also, patients in the HPAC group had better ADLs with less length of PAC than those in the IPAC group.

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## Ethical Approval

The study was approved by the Research Ethics Committee of the Taipei City Hospital (TCHIRB-10710101-E).

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