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Comparisons of mortality and rehospitalization between hip-fractured elderly with outpatient rehabilitation and those without

A STROBE-compliant article

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Abstract

Geriatric patients with hip fractures have high mortality. This study aimed to compare the mortality and rehospitalization of recipient and nonrecipient of outpatient rehabilitation in hip-fractured elderly.

This retrospective cohort study used nationwide claims data in Taiwan and included 3585 senior citizen patients admitted for hip fractures between January 1, 2005, and December 31, 2012. Patients were divided into the recipient (717) and nonrecipient (2868) of outpatient rehabilitation during the first 3 months after hospital discharge. Each patient was followed up for 1 year. Mortality rates of hip-fractured elderly after discharge during the first 3-month period in different groups were analyzed with Chi-square test. Cox proportional hazards regression model was employed for both death and rehospitalization risk analyses.

The mortality rate of the rehabilitation group was lower than that of the nonrehabilitation group (12.69% vs 16.70%, $P < .05$). A more beneficial effect was observed for patients receiving continuous rehabilitation. The rehabilitation group had a lower adjusted risk of death [hazard ratio (HR) = 0.74; 95% confidence interval (95% CI): 0.59–0.94] than that of the nonrehabilitation group. However, the rehabilitation group was at a higher risk of rehospitalization (HR = 1.37; 95% CI: 1.22–1.55).

Hip-fractured elderly receiving outpatient rehabilitation have a lower risk of death but a higher risk of rehospitalization than those not receiving rehabilitation within 1 year after fracture.

Abbreviations: ACG = Adjusted Clinical Groups, CCI = Charlson comorbidity index, CI = confidence interval, HR = hazard ratio, NHI = National Health Insurance, NHIRD = National Health Insurance Research Database.

Keywords: elderly, hip fracture, hospitalization, mortality, outpatient rehabilitation

1. Introduction

Elderly patients with proximal femoral fractures involving the hip joint often experience a decreased mobility, even after surgery. These patients encounter deconditioning and the subsequent complications, which increase mortality as well as financial burdens.[1–3] In Taiwan, hip fracture has become a major public health issue, with the incidence of around 57 per 10,000 elderly people for each year.[4] Along with the population aging, the percentage of the global population aged ≥65 years will reach 25% in 2050; the global annual number of hip fractures at that time may exceed 7 million.

According to the review by Haleem et al in 2008,[5] the mortality rates are 11% to 23% at 6 months and 22% to 29% at 1 year after a hip fracture. Many factors such as sex, age, comorbidity score, residence, fracture type, physical function, cognitive function, mobility, ethnicity, education level, and osteoporosis have been reported to be associated with the prognosis or mortality of hip fractures.[6–14] Because pre-fracture comorbidities and functions cannot be changed, the treatment of patients with motivation, encouragement, and early mobilization after surgery should be emphasized for reducing subsequent adverse outcomes such as functional decline and frailty.[15,16] Recent studies have revealed that post–hip fracture rehabilitation is clinically crucial for functional recovery, and it can reduce the mortality rate.[17–20] Several types of rehabilitation programs can be provided. Patients can receive hospitalized rehabilitation, outpatient rehabilitation services, or home-based rehabilitation programs depending on the available medical facility, the coverage of health care system, and the patients' choices.

Taiwan launched the National Health Insurance (NHI) program in 1995. The range of care covered by the NHI includes inpatient and ambulatory care, dental services, traditional Chinese medicine, child delivery services, chronic mental illness

Editor: Ilke Coskun Benlidayi.

Funding/support: This research was supported in part by the Ministry of Science & Technology (MOST 106-2914-I-010-002-A1; MOST 106-2410-H-010-017-) and National Yang-Ming University Hospital (RD2015-022) in Taiwan.

The preliminary results were presented at the 21st International Association of Gerontology and Geriatrics (IAGG) World Congress in San Francisco, July 23–27, 2017.

The authors report no conflicts of interest.

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Medicine (2018) 97:19(e0644)

Received: 29 June 2017 / Accepted: 12 April 2018

http://dx.doi.org/10.1097/MD.0000000000010644

care, home care, and outpatient rehabilitation. More than 99% of the 23 million Taiwanese citizens and legal residents are enrolled, and more than 90% of medical care providers have contracted with the NHI. However, before 2016, the NHI in Taiwan did not cover inpatient services of post–acute care for hip fracture that have been integrated into the care regimens in many countries. Patients with hip fractures usually receive surgical services under hospital payment systems, based on diagnosis-related groups, and they can visit outpatient rehabilitation services after discharge. Outpatient rehabilitation provides physical therapy programs for hip-fractured elderly according to individual postoperation evaluation by physiatrist or physical therapist, and often includes modality, manual, and exercise therapy for pain alleviation, range of motion, strength, endurance, and functional recovery. Although the accessibility of medical services is high in most parts of Taiwan, little information is available regarding the effectiveness of outpatient-based rehabilitation services for geriatric patients after hip fracture.

Therefore, the objective of this study was to investigate the effectiveness of outpatient rehabilitation service, by focusing on 2 selected outcomes 1 year after hip fracture, including the mortality rate and rehospitalization risk, in the elderly.

2. Methods

2.1. Research design and data sources

The present study was a retrospective cohort study. Data were obtained from 1 million people selected in 2005 from the NHI Research Database (NHIRD) in Taiwan. All patients aged ≥65 years who were admitted for hip fracture between January 1, 2005, and December 31, 2012, were included (Fig. 1). Patients with hip fractures were defined as those receiving a diagnosis of hip fracture (International Classification of Diseases, Ninth Revision, Clinical Modification codes 820.XX) followed by a hospitalized surgery (codes 64028C, 64029B, 64030B, 64170B, 64162B, 64041C, 95005C, and 95017C). Patients who received a diagnosis of pathological fracture (codes 733.14 and 733.15) and mechanical complication of internal orthopedic device (code 996.4) were excluded. In total, 5332 patients met the primary criteria. The average incidence rate of geriatric hip fracture per 10,000 persons per year was around 66. This value is similar to that reported in a previous study,[4] suggesting our data were valid. If the patients received outpatient rehabilitation (with the NHI physical therapy insurance claim codes of 42001~42015) during the first 3 months after hospital discharge, they were assigned as recipient group. The remaining patients were assigned as nonrecipient group. The recipient and nonrecipient groups consisted of 732 and 4600 patients, respectively. In addition, patients had physical therapy claims in each month during the first 3 months periods after hospital discharge were considered as a continuous rehabilitation group in the further analysis.

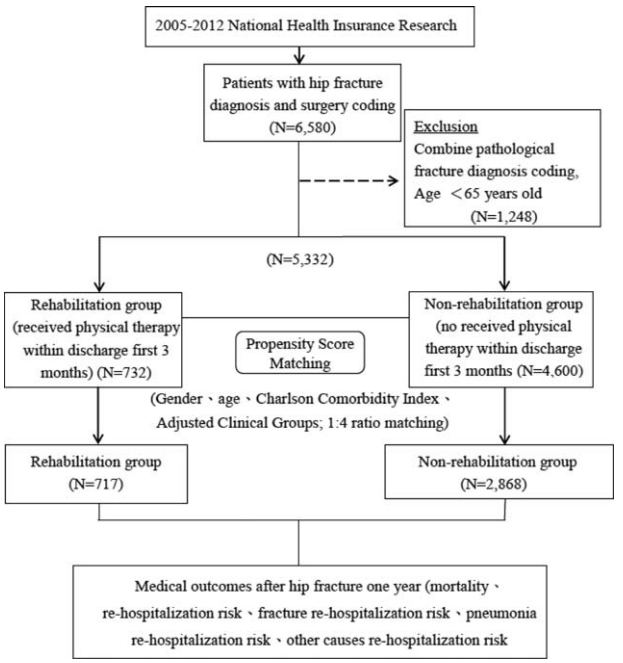

Figure 1. The flow diagram of study participants.

2.2. Matching

To reduce the potential selection bias of the assignment on rehabilitation, propensity score matching by sex, age, comorbidity, and functional status at a 1:4 ratio was employed. Comorbidities were assessed using the widely adopted Charlson comorbidity index (CCI), which covers 17 major diseases, including cardiovascular conditions, chronic pulmonary disease, cancer, kidney diseases, diabetes, digestive diseases, and acquired immune deficiency syndrome.[21] The functional status was measured by using the Adjusted Clinical Groups (ACG) system, which was developed by the Johns Hopkins University for administrative data analysis.[22–24] If patients had any of the following conditions, the medical frailty marker was turned on, and they were referred to as frail: malnutrition, dementia, impaired vision, decubitus ulcer, incontinence of urine, loss of weight, incontinence of feces, morbid obesity, poverty, barriers to access of care, difficulty in walking, or falls.

2.3. Outcome measures and covariates

Each patient was followed up for 1 year after hip fracture for medical outcomes. The primary independent variable was hip-fractured geriatric patients with or without receiving outpatient physical rehabilitation, and the dependent variables were medical outcomes. Medical outcomes including mortality and rehospitalization within 1 year post hip fracture were analyzed. Death was defined as the withdrawal of the patient from the NHI Program. The causes of rehospitalization were classified into fracture, pneumonia, and other causes. The risk of rehospitalization was also compared between the rehabilitation and non-rehabilitation groups. In addition, to better control the potential confounding effect on the benefit of rehabilitation, the duration of hospital stay and use of anti-osteoporosis drug were additionally adjusted in the advanced analysis. The duration of hospital stay was defined as the length of stay in days for patients hospitalized for hip fracture. The use of anti-osteoporosis drug was defined as having being prescribed the medications covered by the health insurance, before the occurrence of hip fracture, for the treatment of osteoporosis.

2.4. Data analyses

Continuous variables were all categorized into subgroups based on the distribution among analyzed patients. Statistical analysis included the comparison of descriptive statistics between the 2 groups and multivariate statistical analyses. Student *t* and Chi-square tests were

Table 1

Characteristics of hip-fractured elderly before and after propensity matching between rehabilitation and nonrehabilitation groups.

	Before matching			After propensity-matching		
	Rehabilitation	Nonrehabilitation	*P*	Rehabilitation	Nonrehabilitation	*P*
Total, n	732	4600		717	2868	
Gender, n (%)			.021*			.872
Male	308 (42.08%)	1727 (37.54%)		293 (40.86%)	1184 (41.28%)	
Female	424 (57.92%)	2873 (62.46%)		424 (59.14%)	1684 (58.72%)	
Age, mean ± SD	80.20 ± 6.65	80.19 ± 7.35	.965	80.17 ± 6.69	80.46 ± 7.01	.329
Age stratification, n (%)			.021*			.973
65–74	142 (19.40%)	1082 (23.52%)		142 (19.80%)	579 (20.19%)	
75–84	387 (52.87%)	2212 (48.09%)		376 (52.44%)	1499 (52.27%)	
≥85	203 (27.73%)	1306 (28.39%)		199 (27.75%)	790 (27.55%)	
CCI, mean ± SD	1.64 ± 1.66	1.52 ± 1.65	.087	1.59 ± 1.63	1.60 ± 1.66	.860
CCI scale, n (%)			.161			.989
0	208 (28.42%)	1490 (32.39%)		208 (29.01%)	838 (29.22%)	
1	215 (29.37%)	1281 (27.85%)		215 (29.99%)	857 (29.88%)	
2	128 (17.49%)	834 (18.13%)		126 (17.57%)	489 (17.05%)	
3	85 (11.61%)	463 (10.07%)		80 (11.16%)	338 (11.79%)	
≥4	96 (13.11%)	532 (11.57%)		88 (12.27%)	346 (12.06%)	
ACG, n (%)			.008†			.957
Positive	148 (20.22%)	745 (16.20%)		133 (18.55%)	527 (18.38%)	
Negative	584 (79.78%)	3855 (83.80%)		584 (81.45%)	2341 (81.62%)	

ACG = Adjusted Clinical Groups, CCI = Charlson Comorbidity Index; Significant difference (*$P < .05$, †$P < .01$) according to Chi-square test.

used for the comparison of patient characteristics between groups, as appropriate. For multivariate statistical analysis, a Cox proportional hazards regression model was used for testing the statistical differences in medical outcomes. On comparing the rehospitalization risk between the groups, 2 factors, namely, the duration of hip fracture hospitalization (in days) and the use of anti-osteoporotic drugs, were considered as the adjustments of potentially confounding factors. To examine the main causes of rehospitalization more effectively, secondary analysis was conducted and all rehospitalizations were further categorized as rehospitalization owing to fracture, pneumonia, or other causes. Differences were considered significant at $P < .05$. All analyses were conducted using SAS version 9.4 (SAS Institute, Inc., Cary, NC).

2.5. Ethics

Patient identities and institution data in the NHIRD were cryptographically scrambled by the National Health Research Institutes before being made available to researchers. The study was without conflict of interest and approved by the Institutional Review Board of National Yang-Ming University Hospital (No. 2014A029).

3. Results

3.1. Characteristics of patients

There were totally 717 and 2868 hip fracture elders recruited in rehabilitation and nonrehabilitation groups, respectively, after propensity matching (Table 1). Before matching, the proportions of female and ACG-negative patients were larger in the nonrehabilitation group (62.46% and 83.8%, respectively) than in the rehabilitation group. Age stratifications were significantly different in the rehabilitation and nonrehabilitation groups, although patients aged between 75 and 84 years accounted for the majority in both groups (52.87% and 48.09%, respectively) before matching. All characteristics including sex, age, age stratification, CCI, CCI score, and ACG functional status after propensity matching did not differ significantly.

3.2. Medical outcomes

The mortality rates in hip-fractured elderly after discharge during the first 3 months are presented in Table 2. The patients receiving the outpatient rehabilitation during the first 1 to 3 months after hospital discharge exhibited a significantly lower mortality rate

Table 2

Mortality rate of hip-fractured elderly after discharge during the first 3-month period in rehabilitation, nonrehabilitation, continuous rehabilitation, and noncontinuous rehabilitation groups.

	n/Mortality rate (%)		
Period after discharge	Rehabilitation	Nonrehabilitation	*P*
During the first 1 mo	464/13.5	3121/16.31	.095
During the first 2 mo	603/13.76	2982/16.33	.131
During the first 3 mo	717/12.69	2868/16.70	.010*
	Continuous rehabilitation	Noncontinuous rehabilitation	
During the first 1 mo	464/13.5	3121/16.31	.095
During the first 2 mo	294/11.56	3291/16.29	.042*
During the first 3 mo	224/8.48	3361/16.39	.002†

Significant difference (*$P < .05$, †$P < .01$) according to Chi-square test.

Table 3

Risk of 1-year mortality and rehospitalization of hip-fractured elderly associated with outpatient rehabilitation.

a. Mortality							
		Unadjusted			Adjusted*		
Variable, n (%)	n	HR	95% CI	P	HR	95% CI	P
Nonrehabilitation	2868						
Rehabilitation	717	0.72	(0.58–0.90)	.004†	0.74	(0.59–0.94)	.011*
b. Rehospitalization							
Rehospitalization, 1650 (100)							
Nonrehabilitation (reference)	2868						
Rehabilitation	717	1.38	(1.22–1.56)	<.001‡	1.37	(1.22–1.55)	<.001‡
Fracture rehospitalization, 93 (5.63)							
Nonrehabilitation (reference)	2868						
Rehabilitation	717	0.83	(0.48–1.43)	.492	0.86	(0.49–1.48)	.579
Pneumonia rehospitalization, 291 (17.64)							
Nonrehabilitation (reference)	2868						
Rehabilitation	717	1.29	(0.98–1.69)	.072	1.27	(0.96–1.67)	.091
Other diagnosis rehospitalization, 1279 (77.52)							
Nonrehabilitation (reference)	2868						
Rehabilitation	717	1.28	(1.12–1.47)	<.001‡	1.28	(1.12–1.46)	<.001‡

The sum of percentages of 3 rehospitalization causes is more than 100% means that there are patients readmitted with multiple causes.

Significant difference (*$P<.05$, †$P<.01$, ‡$P<.001$) according to Cox proportional hazards regression model.

CI = confidence interval, HR = hazard ratio.

* Adjusted for days of hip fracture hospitalization, use of anti-osteoporosis drug.

than that of the patients without rehabilitation (12.69% vs 16.70%, $P<.05$) during the first 3 months. A more beneficial effect was observed for those receiving continuous rehabilitation, with the mortality rates of 13.15%, 11.56%, and 8.48% in the first, second, and third months following rehabilitation. After adjustment for the duration of hip fracture hospitalization and the use of anti-osteoporotic drugs, the rehabilitation group had a statistically significant lower risk of death 1 year after hip fracture [hazard ratio (HR) = 0.74; 95% confidence interval (95% CI): 0.59–0.94; Table 3].

However, the patients in the rehabilitation group were at a higher risk of rehospitalization after adjustment (HR = 1.37; 95% CI: 1.22–1.55; Table 3). After adjustment, the patients in the rehabilitation group had a slightly lower risk of fracture rehospitalization (HR = 0.86; 95% CI: 0.49–1.48) and a slightly higher risk of rehospitalization for pneumonia (HR = 1.27; 95% CI: 0.96–1.27) than did the patients in the nonrehabilitation group. Diagnoses other than fracture or pneumonia made a greater contribution to increasing the risk of rehospitalization in the rehabilitation group than in the nonrehabilitation group (HR = 1.28; 95% CI: 1.12–1.46) after adjustment. The statistical results were consistent between the unadjusted and adjusted analyses for comparing the risks of rehospitalization and rehospitalization due to fracture, pneumonia, or other causes between the 2 groups.

4. Discussion

According to our analyses, mortality rate in hip-fractured elderly who receive outpatient rehabilitation was lower than their counterparts after hospital discharge. This result supports the belief that rehabilitation is beneficial for the medical prognosis of patients with hip fractures after surgery, as previous studies have reported.[17,18] Several types of rehabilitation programs are available after hip surgery. Postacute care programs for hip fracture provide continuous rehabilitation training after hip surgery and can be executed in hospital or community. Integrated care from several medical teams is easy to achieve in hospital-based programs, but it is expensive.[25] Community-based programs are often conducted in institutions, such as long-term care institutions, nursing homes, skilled nursing facilities, and day care centers.[26] Patients can return to the community and receive training and living care. They frequently should live with residents with other different illness and disability that less specialized training for hip fracture residents can be performed. Several studies have reported the effectiveness of home-based programs. Frail elderly patients can conveniently receive rehabilitation after hip fracture surgery, but the cost-effectiveness requires further evaluation.[20,27] In our study, the outpatient services from rehabilitation programs continuously provided by medical centers, community hospitals, or specialty clinics for hip-fractured elderly after surgical intervention proved beneficial for medical prognosis. Patients could be discharged early and could readapt to their daily activities at home. Considering the applicability of outpatient rehabilitation service, physical therapy conducted in outpatient is an acceptable form in areas with convenient transportation. As our data further showed its good effectiveness for the reduction of mortality risk, outpatient rehabilitation can be considered as a choice of treatments for fractured elderly at their postacute phase.

The elderly patients who received continuous rehabilitation after hip fracture discharge exhibited lower mortality rates than those of the noncontinuous rehabilitation group. The difference was significant and was noted as early as during the first 2 months after discharge. These findings provided evidence similar to that on early and intensive rehabilitation programs in stroke patients.[28,29] As compared with the data from previous randomized controlled trials by Sylliaas et al,[30,31] our study encompassed larger sample size and also demonstrated significant benefit for hip-fractured elderly receiving rehabilitation with more physical training at the postsurgery phase. Hip-fractured elderly easily lose the muscle strength of their lower limbs and become frail. Continuous rehabilitation can therefore provide more training and more effectively prevent deconditioning and

the subsequent high mortality rate in hip-fractured elderly than noncontinuous rehabilitation does.

Fall-related accidents and refractures are common in hip-fractured elderly.[32] These accidents also contribute to a high mortality rate. Our analyses revealed that the rehabilitation group had a lower rehospitalization tendency due to refracture within 1 year post hip fracture than did the nonrehabilitation group. Although the outpatient rehabilitation program did not provide as high intensity as the inpatient postacute care program did, the elderly patients could improve their ability to prevent a second fracture injury. However, in contrast to our expectations, the rehabilitation group had a higher rehospitalization risk than the nonrehabilitation group did in this study. Notably, compared with the nonrehabilitation group, the rehabilitation group appeared to have a higher pneumonia rehospitalization risk and had a higher risk of rehospitalization due to other diagnoses, except for refracture. Pneumonia was a crucial comorbidity related to mortality after hip fracture in geriatric patients.[33,34] Geriatric patients visiting outpatient services in hospitals or clinics may have experienced increased exposure to respiratory infections, and this may account for the higher risk of pneumonia rehospitalization observed in the rehabilitation group. Similar results indicating that physical therapy can reduce falls but not rehospitalization rate were also found in a previous study.[35] Furthermore, the higher rehospitalization risk due to other diagnoses found in the rehabilitation group might be attributable to different health care services delivered in different groups. Usually, hip-fractured elderly receiving rehabilitation services also obtain assistance from a multidisciplinary team providing individualized care.[36,37] Orthopedic surgeons, physicians, clinical pharmacists, physical therapists, occupational therapists, respiratory therapists, dietitians, and other specialists can be integrated by the nursing care manager as liaison services.[38] An integrated geriatric hip fracture team can provide individualized services for geriatric patients. For example, if the patient has multiple drug prescriptions, the clinical pharmacist can suggest a suitable prescription to avoid sedatives or other drugs with side effects that may cause falls. For environmental factors related to falls, the occupational therapist can provide an environmental modification strategy after visiting the patient's home. Patients with good compliance with outpatient rehabilitation services for hip fracture were assumed to have higher health awareness and greater family support than those without acceptable compliance. Hence, the number of claims for hospitalization due to other diagnoses was higher in the rehabilitation group than in the nonrehabilitation group, particularly in areas with conveniently available medical facilities.

The NHIRD has covered >90% of residents and medical institutes for decades in Taiwan. Through these extensive data with a large sample size, we could first examine the effectiveness of outpatient rehabilitation for hip fracture in the elderly. The claims of each insured patient over time and all the claims from different medical institutes during the study period were obtained completely for analysis. Thus, our longitudinal cohort study design for mortality and rehospitalization rate in hip-fractured elderly enabled us to avoid the low response and high dropout rates present in most prospective longitudinal studies. Moreover, by using the NHIRD, propensity score matching was performed to reduce factors interfering with the effectiveness of rehabilitation. However, given the nature of secondary data analysis based on the medical claims, some requirements set in the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) may be difficult to comply with and further address in our paper. They include, at least, the estimation of study size, and information of missing data. Furthermore, details on rehabilitation program for different fractures or surgery types and utilization such as intensity, frequency, and cost were poorly described in this study. Attributing rehospitalization to a single reason is difficult. On the basis of previously reported comorbidities after hip fracture, we divided rehospitalized patients into rehospitalization due to fractures, pneumonia, and other diagnoses.[33,34,39] The risk of rehospitalization due to other diagnoses was significantly higher in the rehabilitation group than in the nonrehabilitation group in our study. The risks associated with other rehospitalization diagnoses require clarification. Further analysis and prospective studies are required to provide further evidence for outpatient rehabilitation cost-effectiveness in hip-fractured elderly.

In summary, geriatric patients with hip fractures receiving outpatient rehabilitation during the first 3-month period after discharge have a lower risk of death within 1 year post hip fracture. A more beneficial effect was observed for patients receiving continuous rehabilitation, but these patients had a higher risk of rehospitalization than that of patients without rehabilitation. More studies providing further elucidation are required.

Author contributions

Conceptualization: Po-Jung Pan, Gau-Jun Tang, Tzuo-Yun Lan.
Data curation: Pin-Hsun Lin.
Formal analysis: Po-Jung Pan, Pin-Hsun Lin, Tzuo-Yun Lan.
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Methodology: Pin-Hsun Lin, Gau-Jun Tang, Tzuo-Yun Lan.
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Resources: Tzuo-Yun Lan.
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Supervision: Gau-Jun Tang, Tzuo-Yun Lan.
Validation: Tzuo-Yun Lan.
Writing – original draft: Po-Jung Pan.
Writing – review & editing: Po-Jung Pan, Tzuo-Yun Lan.

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