

Original article

One-year mortality rate after fragility hip fractures and associated risk in Nan, Thailand



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ARTICLE INFO

Article history:

Received 3 December 2019

Received in revised form

12 February 2020

Accepted 21 May 2020

Available online 23 June 2020

Keywords:

Osteoporotic hip fracture

Fragility hip fracture

Mortality rate

Risk factors

ABSTRACT

Objectives: Fragility hip fracture is a common secondary complication of osteoporosis, which leads to significant morbidity and mortality. The incidence and prevalence of hip fractures have increased over recent decades. This study established an objective to determine the mortality rate and potential risk factors in fragility hip fracture patients.

Methods: Electronic medical records were retrospectively reviewed. A total of 1412 patients, aged 50 years and over, who sustained and received treatment for hip fractures between 2014 and 2018 were subsequently identified. Mortality rate data were retrieved from the official statistics registry for the provincial population. The mortality rates and potential risk factors for mortality were examined using Kaplan-Meier estimates and multivariate Cox proportional hazard models.

Results: The overall 1-year mortality rate of fragility hip fracture patients was 19%. Compared with the age-matched population in Nan province, hip fractures increased the mortality rate by 6.21 times. Additionally, the mortality of hip fracture patients was significantly higher among those with age above 80 years, nonambulatory status before fracture and upon hospital discharge, end-stage renal disease, delirium, and pneumonia.

Conclusions: Patients who sustained hip fractures had approximately 6 times higher mortality. Effective strategies for hip fracture prevention as well as improvement in the standard of care are crucial steps towards reducing mortality in patients with hip fracture.

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1. Introduction

Over recent decades, osteoporotic hip fracture has become a global public health challenge. This is largely attributable to an aging global population. However, substantial variability in the incidence rates across the world has been reported [1]. The incidence of osteoporotic hip fracture has been well documented in the Western world that subsequently reached a plateau or decreased from 1980 [2]. However, epidemiological data from the Eastern world has not been widely reported. Of the limited number of studies, the age-adjusted incidence rate of the population aged 65

and over decreased from 381.6 for men and 853.3 for women in 2001 to 341.7 and 703.1 (per 100,000 population), respectively, in 2009 within a study population from Hong Kong [3]. In Japan, the estimated number of new hip fracture patients in 2012 was 175,700 in total, 37,600 for men and 138,100 for women. The incidence rates in both men and women aged 70–79 years were the lowest in the 20-year period from 1992 to 2012 [4]. In contrast, the incidence rate of hip fracture (per 100,000 population) in South Korea has increased by 14.1% over the 5-year period [5]. In Northern Thailand, the incidence of hip fracture has been increasing over the past decades with 151.2–185.2 per 100,000 population in Chiang Mai (1997–1998) and 211.6–238.5 per 100,000 population in Nan (2015–2017) [6–8].

Hip fracture represents one of the most common injuries among the elderly population and is associated with significant morbidity and mortality, leading to significant economic and healthcare

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Peer review under responsibility of The Korean Society of Osteoporosis.

burdens [9]. Although several risk factors for mortality related to fragility hip fracture including male sex, older age, presence of chronic illnesses, prefracture ambulatory ability, types of treatment, and duration before surgery have been identified [10–14], mortality rates among this population remain high [15]. The most critical period influencing mortality rate is the first year following the hip fracture. The 1-year mortality rate has reached 30% [16]. Globally, the 1-year mortality rate was 24% in the 1980s, 23% in the 1990s, and was declined to 21% after 1999. However, in Chiang Mai (Thailand), the 1-year mortality rate has been increasing. Between 1998 and 2003 the mortality rate was found to be around 18% and has risen incrementally to around 21.1% in 2006–2007 [11,17–19]. More recently, Anghthong et al. [20] in 2013, argued that the 1-year mortality rate was only 4.7% (2007 and 2008).

Previous studies have shown that mortality rates related to osteoporotic hip fracture considerably vary in different regions of Thailand. There is differential in healthcare services between Chiang Mai and Nan. First of all, Nan is a small province with half of the size of Chiang Mai for both population and areas. Additionally, Nan has only 2 main hospitals that can treat hip fracture patients whilst Chiang Mai has 15 hospitals with the full capabilities to treat patients with hip fractures. As a result, these discrepancies might affect the quality of healthcare services and mortality following hip fracture in Nan. Little is known regarding the mortality rates in different areas in Thailand. Addressing this issue could provide valuable information to medical personnel in perioperative patient optimization and stratification of patients in order to minimize devastating complications. This study established a primary objective to determine the difference in mortality rate among those who sustained a fragility hip fracture and age-matched population in Nan province. The secondary objective was to determine potential risk factors for mortality.

2. Methods

This retrospective cohort study included consecutive patients who sustained hip fracture at Nan Hospital and Pua Crown Prince hospital relevant to the period between January 1st, 2014 to December 31st, 2018. The inclusion criteria were those who aged >50 years old, received treatment for hip fracture including neck, intertrochanteric, or subtrochanteric femoral fractures and were admitted to these 2 hospitals in the study period. Foreign patients or patients who were sustained hip fractures due to pathologic fracture, infection, high-energy trauma, and poly-trauma were excluded from this study. Data regarding the general population in Nan province, Thailand were obtained from the official statistics registry (URL http://stat.dopa.go.th/stat/statnew/upstat_age.php). The incidence of primary and secondary fractures from Pua Crown Prince Hospital was retrieved from Nan provincial public health office.

Data was obtained from in-patient medical records and out-patient follow-up notes at least 1-year after sustaining an osteoporotic hip fracture. The patient's information and prefracture medical history were recorded including age, sex, pre- and postfracture ambulatory ability, general medical conditions, fracture characteristics, history of refracture, pre- and postoperative assessment, type of treatment, the time from injury to treatment, and the length of hospitalization. Identification of death, and the date of death were obtained through telephone interviews and home visits by the nurse and other medical personnel. For the length of hospitalization, data were categorized by percentiles of the overall length of stay in hip fracture patients into 2 groups; hospital stay duration amongst 0th–75th percentiles (<8 days) and above 75th percentiles (≥ 8 days).

Statistical analyses were performed using SPSS ver. 14.0. (SPSS

Inc., Chicago, IL, USA). For trends in mortality, crude mortality rates were calculated. Linear trends were tested by using the Cochran-Armitage trend test. The basic characteristics and covariates in this study were summarized using mean, median, and standard deviation for continuous data as appropriate whilst categorical data were presented as frequencies and percentages. The Kaplan-Meier survival analysis method was carried out to estimate the mortality rate. Univariate and multivariate Cox proportional hazard models were performed to examine the impact of potential associated factors on mortality. This study was approved by the research ethics committee of the Nan Hospital (COA No. 006, Nan Hos REC No.006/2019).

3. Results

Between 2014 and 2018, the total number of hip fracture patients was 1412. Of these patients, 411 patients (29.1%) were male, and 1001 patients (70.9%) were females. The mean age was 78.8 ± 8.85 years for all patients. The mean duration of follow-up was 22.18 months (range, 1–60.83 months). The overall mortality rates in Nan general population were significantly decreased by 5.65% and individuals with hip fractures revealed a statistically significant decreasing trend in mortality by 52.43% ($P < 0.002$) during the study period. Table 1 summarizes the mortality rate amongst the provincial population and patients who sustained hip fracture in Nan, Thailand between 2014 and 2018.

The 1-, 3-, and 6-month overall mortality rates after hip fractures were 5%, 10%, and 13%, respectively. The 1-year overall mortality rates following hip fractures were 19% as shown in Kaplan-Meier analysis (Fig. 1).

A total of 1412 patients with osteoporotic hip fractures were initially included to examine the trend in mortality rates, of which 36 patients who deceased during hospital admission were excluded. This is because other comorbidities in hospitalized patients might confound mortality among patients who sustained hip fractures in the present study. Moreover, we excluded 196 patients from the analysis as they did not have adequate information. Therefore, a total of 1180 patients were included in the analysis, of which 333 patients (28%) were males, and 847 patients (72%) were females. The mean age was 78.50 ± 8.91 years for all patients. The median length of hospitalization was 5.50 ± 5.17 days for those who had undergone operative treatment, and 3.00 ± 6.25 days in the nonoperative treatment group. The mean duration of follow-up was 23.70 months (range, 1–60.83 months). Of these 1180 patients, 353 patients (29.92%) died of any causes by the end of this study. Demographic and clinical characteristics including age, sex, pre- and postfracture ambulatory ability, body mass index (BMI), diagnosis, hospitalization length, refracture, and type of treatment were demonstrated in Table 2.

Cox proportional hazard regression models were performed to examine risk factors for mortality in this study (Table 2). In the multivariate analysis, the potential risk factors including age, sex, type of treatment, pre- and postfracture ambulatory ability were adjusted. The mortality was significantly higher in older patients, with adjusted hazard ratio [HR] 2.36 (95% confidence interval [CI], 1.66–3.36) for those aged over 80 years. Male sex was found to be a significant risk for mortality; Males were at 42% higher risk of mortality compare with females individuals (HR, 1.42; 95% CI, 1.14–1.77). Moreover, individuals with BMI less than 21 kg/m^2 had significantly higher mortality risk than those who had BMI over 21 (HR, 1.70; 95% CI, 1.30–2.21). Both poor prefracture ambulatory ability (HR, 2.34; 95% CI, 1.29–4.23) and poor postfracture ambulatory ability (HR, 2.25; 95% CI, 1.74–2.90) were significantly associated with increased mortality.

The anatomical location of hip fractures did not significant

Table 1

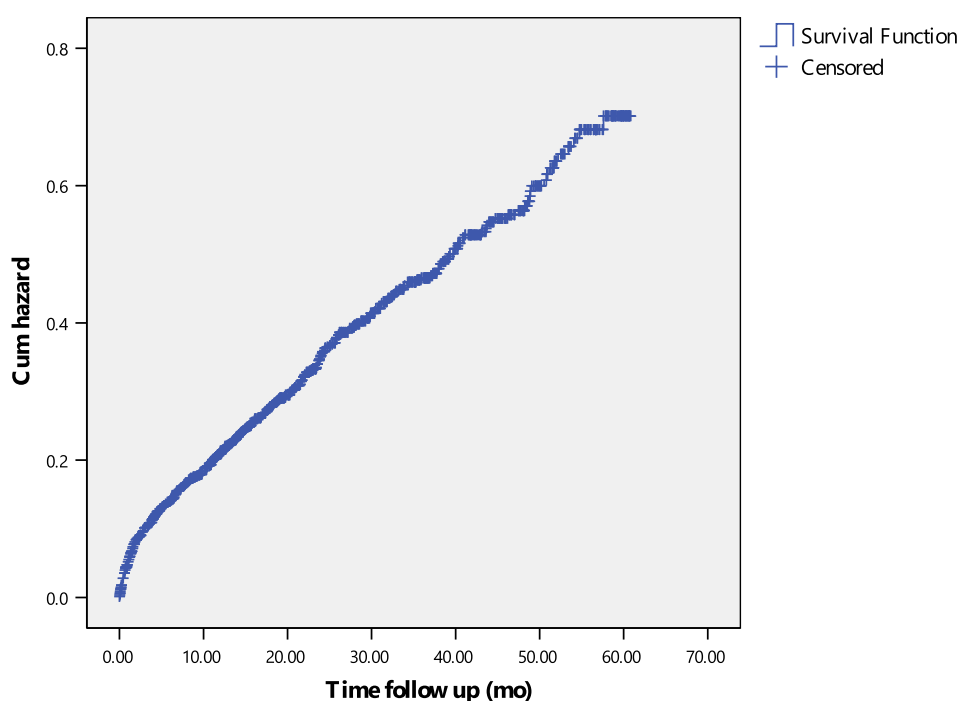
The mortality rates in provincial population and patients with hip fracture (aged over 50 years) in Nan, Thailand.

Year	Nan population			Patients with osteoporotic hip fracture			Relative risk (95% CI)
	Total	Deaths	Mortality rates ^a	Total	Deaths	Mortality rates ^a	
2014	127,234	2795	2196.74	259	47	18,146.72	8.38 (6.46–10.89)
2015	132,829	2951	2221.65	264	35	13,257.58	6.03 (4.42–8.22)
2016	138,191	2922	2114.46	286	41	14,335.66	6.89 (5.16–9.13)
2017	142,987	3035	2122.57	325	39	12,000.00	5.71 (4.25–7.69)
2018	148,031	3068	2072.54	278	24	8633.09	4.19 (2.85–6.15)
Total							6.21 (5.43–7.11)
P-value ^b	0.012			0.002			

CI, confidence interval.

^a Deaths per 100,000 population.^b Cochran-Armitage trend tests.

Hazard function

**Fig. 1.** Kaplan-Meier estimate of the overall mortality rates in patients after hip fractures.

impact the mortality (HR, 0.92; 95% CI, 0.72–1.18; $P = 0.5$ and HR, 1.19; 95% CI, 0.62–2.26; $P = 0.6$). Similarly, mortality did not differ significantly between patients with nonoperative treatment and those who underwent operative treatment (HR, 1.33; 95% CI, 0.99–1.80; $P = 0.06$). Patients who had been hospitalized for longer than 8 days had 1.56 times higher risk of mortality than those who were discharged before 8 days (HR, 1.56; 95% CI, 1.23–1.98; $P < 0.01$).

The association between underlying disease, comorbidities, complications, time to treatment, and mortality in patients with hip fracture are given separately in [Tables 3 and 4](#). History of chronic obstructive pulmonary disease (HR, 1.64; 95% CI, 1.25–2.16), chronic kidney disease (HR, 1.51; 95% CI, 1.11–2.05), dementia (HR, 1.62; 95% CI, 1.15–2.27), end-stage renal disease (HR, 3.76; 95% CI, 2.09–6.77) were significantly associated with higher mortality risk following hip fracture. Furthermore, we found that the prefracture history of urinary tract infection (HR, 1.48; 95% CI, 1.02–2.15), delirium (HR, 2.15; 95% CI, 1.45–3.19) as well as pneumonia (HR,

2.51; 95% CI, 1.09–5.77) were significantly associated with higher mortality. Of note, patients with sepsis were at 79% lower risk of mortality compared with those without a history of sepsis (HR, 0.21; 95% CI, 0.07–0.59).

Patients who arrived at the hospital later than 12 hours after injury had a mortality risk about 1.64–1.73 times ($P < 0.01$) higher than those who arrived at the hospital within 12 hours. Moreover, patients who underwent an operation later than 24 hours from the time of injury had a mortality risk about 1.68–1.78 times ($P < 0.01$) higher than those who underwent an operation within 24 hours.

4. Discussion

The population aged 50 years and older has been growing over the past few decades as people are living longer across the world. As a result, the osteoporotic hip fracture has become a global public health challenge. For the first time, this study has investigated the mortality rates among patients who had a history of sustained hip

Table 2
Univariate and multivariate analyses of factors predictors of mortality in hip fracture patients.

Characteristic	Death, n (%)	Total No.	Crude HR	95% CI	P-value	Adjusted HR ^a	95% CI	P-value
Age, yr								
<70	38 (19)	205						
70–80	106 (25)	421	1.47	1.02–2.14	0.04	1.49	1.03–2.17	0.04
>80	209 (38)	554	2.69	1.90–3.80	<0.01	2.36	1.66–3.36	<0.01
Sex								
Male	122 (37)	333	1.41	1.13–1.75	<0.01	1.42	1.14–1.77	<0.01
Female	231 (27)	847						
Type of treatment								
Nonoperative treatment	89 (54)	166	2.66	2.09–3.38	<0.01	1.33	0.99–1.80	0.06
Operative treatment	264 (26)	1014						
Body mass index (kg/m ²)								
<21	283 (35)	802	2.10	1.62–2.73	<0.01	1.70	1.30–2.21	<0.01
≥21	70 (19)	378						
Prefracture ambulatory ability								
Community ambulator	199 (26)	776						
Household ambulator	142 (37)	384	1.54	1.24–1.91	<0.01	1.19	0.95–1.49	0.12
Cannot walk	12 (60)	20	3.94	2.20–7.07	<0.01	2.34	1.29–4.23	<0.01
Postfracture ambulatory ability								
Can walk	179 (22)	818						
Cannot walk	174 (48)	362	2.84	2.30–3.50	<0.01	2.25	1.74–2.90	<0.01
Diagnosis								
Neck	89 (28)	317						
Intertrochanteric	253 (31)	829	1.08	0.84–1.37	0.56	0.92	0.72–1.18	0.50
Subtrochanteric	11 (32)	34	1.07	0.57–2.01	0.83	1.19	0.62–2.26	0.60
Length of stay, d								
<8	251 (28)	910						
≥8	102 (38)	270	1.65	1.31–2.08	<0.01	1.56	1.23–1.98	<0.01

HR, hazard ratio; CI, confidence interval.

^a Adjusted for age, sex, type of treatment, and ambulatory ability.

Table 3
The associations between underlying diseases, medical comorbidities, and mortality in hip fracture patients.

Characteristic	Death, n (%)	Total No.	Adjusted HR ^a	95% CI	P-value
Underlying diseases					
Hypertension	221 (31)	719	0.92	0.73–1.16	0.50
Chronic obstructive pulmonary disease	86 (46)	186	1.64	1.25–2.16	<0.01
Diabetes mellitus	46 (26)	178	0.84	0.59–1.19	0.32
Chronic kidney disease (GFR<60)	60 (44)	135	1.51	1.11–2.05	0.01
Dementia	45 (48)	93	1.62	1.15–2.27	0.01
Coronary heart disease	23 (35)	66	0.85	0.54–1.35	0.50
Cataract/visual problem	9 (13)	70	0.66	0.34–1.28	0.22
End-stage renal disease (GFR<15)	13 (50)	26	3.76	2.09–6.77	<0.01
Medical comorbidities					
Anemia	124 (39)	316	1.26	0.98–1.60	0.07
Pressure sore	22 (61)	36	1.41	0.89–2.24	0.15
Electrolyte imbalance	81 (40)	204	1.19	0.91–1.54	0.20
Urinary tract infection	39 (45)	86	1.48	1.02–2.15	0.04
Fever	23 (33)	69	1.28	0.82–2.02	0.28
Delirium	36 (67)	54	2.15	1.45–3.19	<0.01
Exacerbate COPD	13 (57)	23	1.00	0.53–1.87	0.99
Sepsis	5 (38)	13	0.21	0.07–0.59	<0.01
Pneumonia	7 (54)	13	2.51	1.09–5.77	0.03
Coagulopathy	4 (27)	15	1.21	0.44–3.35	0.71

HR, hazard ratio; CI, confidence interval; GFR, glomerular filtration rate; COPD, chronic obstructive pulmonary disease.

^a Adjusted for age, sex, type of treatment, and ambulatory ability.

fractures compared to the mortality rates in the general population in Nan, Thailand. The result from this study revealed that the number of deaths per year among the general population was decreased by 5.65% whereas the number of deaths per year of hip fracture patients was notably decreased by 52.4%. However, the mortality risk linked to hip fracture was high compared to other causes of death except for the accident and cancers. The relative risks of mortality of hip fracture patients compared to overall mortality in Nan province have been decreasing 8.38 in 2014, 6.03

in 2015, 6.86 in 2016, 5.71 in 2017, 4.19 in 2018, and 6.21 in 2014 through 2018. Moreover, the overall 1-year mortality rate of fragility hip fracture patients from 2014 through 2018 was found to be 19% in this study, which is similar to the number reported in Chiang Mai (17%–21.1%) and other countries (22%–30%) [11,16–19].

As expected, some demographic factors had an impact on mortality in patients with hip fracture. With regards to age, the present results revealed that patients who were older than 80 years had higher mortality risk 2.36 times than those younger than 70

Table 4
The associations between time to treatment and mortality in hip fracture patients.

Characteristic	Death, n (%)	Total No.	Adjusted HR ^a	95% CI	P-value
Injury to admission					
<12 h	175 (24)	735			
12–24 h	43 (34)	128	1.64	1.18–2.29	<0.01
>24 h	135 (43)	317	1.73	1.38–2.17	<0.01
Injury to surgery					
<24 h	70 (20)	352			
24–72 h	86 (30)	290	1.78	1.29–2.44	<0.01
>72 h	108 (29)	372	1.68	1.24–2.28	<0.01

HR, hazard ratio; CI, confidence interval.

^a Adjusted for age, gender, type of treatment, ambulatory ability.

years ($P < 0.01$), which is consistent with previous studies [11,19,21,22]. Moreover, the impact of walking ability before and after injury at hospital discharged was a substantial factor in mortality rates following the osteoporotic hip fracture. Walking ability is one of the factors reflecting the frailty of patients, which could influence the outcome of treatment and mortality rate [23]. The present results showed that patients who were not able to walk prior to an injury had a higher risk of death compared with those who were community ambulator. Similarly, patients who were nonambulatory upon hospital discharge had approximately 2-fold higher mortality than those who can walk. These findings are similar to previous studies [11–14]. Huang et al. [24] demonstrated that low weight patients ($BMI < 18 \text{ kg/m}^2$) had a higher risk of sustaining fragility hip fractures. The present study demonstrated that patients who had BMI less than 21 kg/m^2 were more likely to die than those with BMI higher than 21 kg/m^2 . These findings are consistent with several studies showing the association between low BMI and increased mortality [25,26]. Regarding other medical comorbidities, the present study demonstrated that end-stage renal failure (ESRD) was found to be the most important comorbidity associated with mortality. This finding is in keeping with previous studies reporting that ESRD was an independent predictive factor of 1-year mortality in patients undergoing hip fracture surgery [27]. Recently, renal failure was also included as 1 out of 9 predictors in the prognostic model for 30-day mortality after hip fracture developed by Karres et al. [28].

Delirium is a frequent complication in patients with hip fracture. Dementia is a potent risk factor for delirium and common in frail and elderly patients. Although the incidence of dementia and delirium were relatively low, both had a high impact on survival outcomes. Chiu reported that dementia was significantly associated with an increased 1-year mortality rate (adjusted HR, 1.45; 95% CI, 1.17–1.79) [29]. Moreover, delirium was found to be correlated with a higher 6-month mortality rate [30]. The present study demonstrated that patients with dementia had a 2 times higher risk of death compared to those without dementia. This positive association between dementia and mortality concurs with a previous study. Similarly, delirium was found to be a significant predictor of mortality in the present study, which is consistent with previous research [30]. Patients with a history of sepsis demonstrated a tendency to lower mortality than those without in the present study. In contrast to, the vast majority of previous studies have indicated that sepsis is an independent risk factor of thirty-day mortality [31]. This may be due to the fact that in this present study we excluded in-hospital dead patients from the analysis and these patients might have developed severe sepsis and subsequently died during admission.

Regarding time to surgery, the present study found a significantly higher survival rate in patients who underwent operative treatment within 24 hours after injury. The findings support

previous studies that patients who underwent surgery within 48 hours (HR, 0.72; 95% CI, 0.64–0.80) and within 24–72 hours (HR, 0.81; 95% CI, 0.68–0.96; $P = 0.01$) demonstrated a decreased risk of mortality at 1-year postoperatively [14,21]. Therefore, it seems that the shorter time from their injury to surgery (treatment) could decrease mortality rates among patients with hip fracture.

The majority of studies on the scoring systems in fragility hip fractures have been developed in Western countries. Yet, it is still unclear whether those scoring systems could be applied in the Asian population. So far, there remains no screening tools or scoring system that could predict the mortality risk of hip fracture patients using demographic characteristics, fracture characteristics, underlying diseases, and medical comorbidities guide treatment, and predict morbidity and mortality.

This paper contains a considerably large number of hip fracture patients from Thailand. In Nan, there are only 2 hospitals (Nan and Pua Crown Prince Hospital) that have orthopedic surgeons who can treat and operate on hip fracture patients. Almost all hip fracture patients would be referred to these hospitals. Therefore, the data presented in this study is representative of the hip fracture patients in Nan province.

This study has several limitations. First, the present results indicated that male sex has higher mortality than female. However, the mortality rates and the risk of mortality in this study are not sex-specific. It would be interesting to investigate the risk of mortality stratified by sex and age in the future study. Secondly, the walking ability reflects the frailty of patients and it has a substantial impact on mortality. The frailty is common findings in geriatrics patient and greatest risk of fall [23]. However, in the present study, the frailty of patients was not considered. It may be worth including this factor as one of the risk factors in future studies. Further research in a multicenter study with large sample size is still warranted in order to develop a prognostic model to predict mortality in patients with fragility hip fractures and to provide the most appropriate treatment plan with favorable prognosis to patients.

5. Conclusions

In 2014 through 2018, the mortality rate among patients who had a history of hip fracture seemed higher than those without hip fracture in the same age group (RR, 6.21; 95% CI, 5.43–7.11). The overall 1-year mortality rate of fragility hip fracture patients was found to be 19%. Patients with hip fractures had worse mortality if they had one of these following risk factors: aged above 80 years, cannot walk before fracture, cannot walk before hospital discharge, ESRD patients, delirium, or pneumonia. Special cautions should be given to patients with mentioned risk factors and may be best managed in a multidisciplinary manner—comanaged by orthopedic surgeons, internists, family physicians, and fracture liaison nurses.

Conflicts of interest

No potential conflict of interest relevant to this article was reported.

CRedit author statement

Nuttorn Daraphongsataporn: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Writing – Original Draft, Writing – Review & Editing. **Surapot Saloa:** Investigation. **Kaiwan Sriruanthong:** Writing – Original Draft, Writing – Review & Editing. **Nattaphon Philawuth:** Formal analysis, Investigation. **Krairoek Waiwattana:** Investigation. **Prapan Chonyuen:** Investigation. **Kununya Pimolbultr:** Formal analysis, Writing – Original

Draft, Writing – Review & Editing. **Worapong Sucharitpongpan:** Methodology, Validation, Formal analysis, Investigation, Data Curation.

Acknowledgments

The author like to thank Siriporn Wongwatcharapaiboon (Nan Hospital, Nan, Thailand) for statistical consultant, and Pilan Jaipanya (Chakri Naruebodindra Medical Institute, Faculty of Medicine Ramathibodi Hospital, Mahidol University, Samut Prakan, Thailand) for manuscript review. **ORCID** Nuttorn Daraphongsatoporn: 0000-0002-3933-373X. Surapot Saloa: 0000-0001-8679-1429. Kaiwan Sriruanthong: 0000-0001-8855-8399. Nattaphon Philawuth: 0000-0001-8763-0205. Krairoek Waiwattana: 0000-0001-9793-1941. Prapan Chonyuen: 0000-0001-8239-7379. Kununya Pimolbultr: 0000-0001-5743-3737. Worapong Sucharitpongpan: 0000-0003-3866-0779.

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