

# Cost-Utility Analysis of Osteoporotic Hip Fractures in Thais

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A prospective study was conducted among osteoporotic hip fracture in 2008. It was aimed to assess cost per quality adjusted life year (QALY) of hip fracture in the context of a developing country. The patients who were diagnosed as hip fracture and admitted to the orthopedic wards were included. Any pathological fractures or missing data were discarded from the analysis. Median cost was evaluated from a societal perspective. EQ-5D was used to assess health utility state and then converted into a time trade off. Cost per QALY was estimated at one year of follow-up. Forty-two patients completed a quality of life assessment. The average age was 75.6 years old and 71% were female. Most of them were undergone either hemiarthroplasty or internal fixation. The median total cost per year was US\$ 4,210.60. The median QALY was 0.636 and cost per QALY was US\$ 6,620.52. Cost utility of a hip fracture in Thai setting was lower than other developed countries due to strong family support and insufficient rehabilitation. However, it has high impact on 78.8% of the Thai Gross National Product. Prevention of hip fracture is needed in underdeveloped countries as much as others, worldwide.

**Keywords:** Cost, QALY, Utility, Hip fracture, Thai

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Hip fracture is the most severe osteoporotic fracture and causes high morbidity and mortality. The incidence is estimated to be 6.3 million by year 2050<sup>(1)</sup> and nearly half of it is predicted to occur in Asia<sup>(2)</sup>. The contribution to health care expenditure will be \$131.5 billion over the next 50 years<sup>(3)</sup>. Not only an economic burden is of concerned in hip fracture, but also quality of life that affects most elderly people must be taken into account. From the systematic review, the impact of hip fracture on quality of life was 0.797 and 0.899 for the first year and second year, respectively<sup>(4)</sup>. However, these data were derived from European countries and USA<sup>(5)</sup>.

Thailand is a developing country in South East Asia. Based on one year, this country confronts hip fractures of 180 per 100,000 population aged more than 50 years old<sup>(6)</sup> with a cost of treatment reaching 60% of National Gross Domestic Products (GDP)<sup>(7)</sup>. In the context of a developing countries, which

has middle-low socioeconomic status and specific health beliefs, cost per quality adjusted life year (QALY) might be in another scale. Therefore, this study was proposed to assess cost-utility analysis of osteoporotic hip fractures in our setting. The results might be useful for policy making in order to support osteoporosis prevention in Third World countries.

## Material and Method

### Study design

Data were recruited from osteoporotic hip-fracture patients who were admitted during January 1, 2008 to December 31, 2008 at Ramathibodi Hospital, Mahidol University, Thailand. The inclusion criteria were patients with osteoporotic hip fractures, aged  $\geq 51$  years old, and willing to participate in the study with informed consent. This study was approved by the Institutional Review Board (IRB). Osteoporotic hip fracture included intertrochanteric and femoral neck fracture (ICD-10 S72.1). Standard internal fixation and/or hemiarthroplasty were applied in each type of fracture. Some patients who had contraindication for surgery such as severe medical conditions were shifted into the conservative treatment. Any secondary hip fracture from tumor or high-energy trauma was excluded

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from the study.

The baseline characteristic included: age, gender, types of fractures, underlying diseases, choice of implants, hospitalization, and complications. The main outcomes were assessed as costs and quality of life.

### Cost

Costs data were collected for one year of follow-up by investigating medical records and interviewing the patients by telephone. The costs were considered from a societal perspective including direct medical costs, direct non-medical indirect costs and were reported in 2008 in Thai currency (THB). Costs were converted from Thai baht (THB) to US dollars by using the annually average exchange rate for 2008.

Direct medical costs according to osteoporotic hip fracture included costs of diagnosis, operative treatment, hospitalization, medications, rehabilitation, readmission and follow-up visit within a year of treatment. Direct non-medical costs were measured from costs of transportation, caregivers, food and clothes, traditional medicine and absence from work (both patients and caregivers). Indirect cost was estimated as the willingness to pay of patients.

### Utility

The quality of life was derived through the Thai version EQ-5D questionnaire by telephone interview. EQ-5D from the European group (EuroQol)<sup>(8)</sup> is a multi-attribute utility measured with five attributes: mobility, self-care, usual activity, pain/discomfort and anxiety/depression. Each attribute has three levels: no problem, some problems and extreme problems. A validated Thai version of EQ-5D was used<sup>(9)</sup>. Consequently, the separate scores were combined into the EQ-5D Index of Thai population based on time trade off (TTO) utility values for EQ-5D health states. Then the EQ-5D Index can be converted into utility scores which 1 means perfect health and 0 means death.

In the calculation of quality of life related to osteoporotic hip fracture, the interview was carried out throughout one year after the operation. Cost utility analysis was estimated as cost/QALY. Cost was derived from either total cost or direct cost of one year after fracture. QALY was retrieved from median EQ-5D at one-year follow-up.

### Statistical analysis

The continuous data were analyzed by using the mean and standard deviation. The categorical data

were calculated as percentage. Cost data often skewed and thus not normally distributed, thus they were estimated using median  $\pm$  SD. Each utility value was calculated by the mean, median, standard deviation, the 25<sup>th</sup> and 75<sup>th</sup> percentile. All statistical values were conducted with STATA 10.0 (StataCorp, Collage Station, Texas). The level of significance (*p*-value) was less than or equal to 5%.

The sample size was estimated by using Power and Sample Size Program (Vanderbilt, version 2.1.31) based on alpha = 0.05 power = 0.8, difference of QALY between our study and others = 0.1, standard deviation of QALY = 0.15. It was 36.

## Results

### Patients' characteristics and baseline information

Sixty-one patients with hip fracture admitted to the orthopaedic wards, Ramathibodi Hospital during 2008. Five of them were excluded from the study due to missing data. The patients' characteristic and baseline information for the 56 fracture patients were showed in Table 1. The average age of patients was 75.6 $\pm$ 10.3 years old, and 71% of them were female. Approximately 75% of the osteoporotic hip fracture patients had underlying diseases such as diabetes mellitus, hypertension, ischemic heart disease, cerebrovascular

**Table 1.** Patients' characteristics and baseline information

Baseline characteristic	Osteoporotic hip fractures (n = 56)
Mean age	75.6 $\pm$ 10.3
Female (%)	40 (71.4)
Underlying diseases (%)	42 (75)
Hip fracture types (%)	
Femoral neck	28 (50)
Intertrochanteric	28 (50)
Implant (%)	
Hemiarthroplasty	29 (51.8)
ABP/DHS/nail	22 (39.3)
Multiple screws	2 (3.6)
No surgery	2 (3.6)
One-year follow-up status (%)	
Independent	12 (21.4)
Partially dependent	25 (44.6)
Totally dependent	5 (9)
Death	5 (9)
Lost of follow-up	9 (16)

ABP = angle blade plate; DHS = dynamic hip screw

**Table 2.** Cost analysis of hip fracture

Cost	Median (range)	
	Baht	US dollars
Total cost	126,319.5 (23,959.6-5,070,921)	4,210.6 (798.7-169,030.7)
Direct cost	60,558.3 (23,751.9-599,454.2)	2,018.6 (791.7-19,981.8)
Direct medical cost	50,520.9 (23,601.9-369,434.9)	1,684.0 (786.7-12,314.5)
Direct non-medical cost	12,000.0 (1,000-400,000)	400.0 (33.3-13,333.3)
Indirect cost	50,000.0 (10,000-5,000,000)	1,666.7 (333.3-166,666.7)

**Table 3.** Frequency of each attribute and level of EQ-5D

EQ-5D	Mobility	Self-care	Usual activities	Pain/discomfort	Anxiety/depression
Level 1	12	24	17	18	24
Level 2	25	9	14	23	15
Level 3	5	9	11	1	3
Total (n)	42	42	42	42	42

Level 1 = no problem, Level 2 = some problems, Level 3 = extreme problems

disease, Parkinson's and renal failure. From 28 intertrochanteric and 28 femoral neck fractures, 53 of them underwent hip surgery. At one year follow-up, 5 patients (9%) were unable to walk independently, 9 patients (16%) were lost of follow-up and 5 patients (9%) were had died.

#### Cost utility analysis

Cost analysis showed the total cost of hip fracture was US\$ 4,210.60 (range 798.7-169030.7 US\$); half of the cost came from direct cost (Table 2). Forty-two patients (75%) out of 56 patients completed the state of health evaluation. Table 3 shows the frequency and proportion of each attribute and level of EQ-5D from 42 patients with a year of osteoporotic hip fracture. Table 4 shows the EQ-5D (Thai tariff) values of one year after hip fracture. The median of utility was 0.636 (95% CI; 0.527-0.744). The average utility was 0.522 (95% CI; 0.413-0.631). Median total cost and direct cost were used to estimate the cost utility analysis. The total cost per QALY was US\$ 6,620.52 and the direct cost per QALY was US\$ 3,173.92 (Table 5).

#### Discussion

Quality of life was interesting, especially in osteoporotic hip fracture over decades. Various studies expressed the value of health status in EQ-5D for hip

**Table 4.** Estimated health-related utility

EQ-5D values	12 months after hip fracture
Median (95% CI)	0.636 (0.527-0.744)
Mean (95% CI)	0.522 (0.413-0.631)
25 <sup>th</sup> percentile (95% CI)	0.300 (0.191-0.409)
75 <sup>th</sup> percentile (95% CI)	0.771 (0.662-0.880)

fractures. Recently, the Thai version of EQ-5D and the convertible formula to TTO was published. This led to the advantage of exploring the quality of life in the Thai context. This present study demonstrated state of health values in the patients who experienced surgery for osteoporotic hip fracture for 1 year. Consequently, with a median total cost per year of US\$ 4,210.6 US\$ and an average QALY of 0.636, the cost/QALY for hip fracture in this study was US\$ 6,620.52.

The cost incurred from hip fracture in Thais was lower than that in other nations. Societal-perspective hip fracture related costs were reported to be between US\$ 8,393-17,400 at the first year after fracture among Australia, Germany, Japan, Spain, Sweden, the United Kingdom (UK) and USA<sup>(10,11)</sup>. The yearly cost of nursing care was even higher between 29,636-67,592 US\$. Cost of care also increased

**Table 5.** Cost of hip fracture per QALY

Cost	Cost (baht)	QALY	Cost/QALY (bahts)	Cost/QALY (US dollars)*
Total cost	126,319.5	0.636	198,615.57	6,620.52
Direct cost	60,558.3	0.636	95,217.45	3,173.92

\*30 baht = 1 US dollar

according to age<sup>(11)</sup>. Cost of treatment in this research depended on health insurance scheme and family support. Most patients have not received rehabilitation, institutional care, and/or full medication for osteoporosis. Unemployed family members took care of them which resulted in very low direct, non-medical costs.

Estimated health-related utility varied among economics, races, cultures, and utility evaluation techniques. According to EQ-5D, the results were compatible with those of some reports<sup>(12,13)</sup> but lower than those of other systematic reviews<sup>(4,5)</sup>. With the different context of cultures and beliefs, hip fracture affects quality of life in developing countries more than those in developed ones due to insufficient health care. Most elderly people in Thailand live in expanded families. Instead of satisfaction of their health status surrounded by plenty of caregivers, hip fracture patients felt more dependent especially in their mobility. Some families did not allow an elderly to do hard work or even walk in order to prevent falling. Combined with an insufficient rehabilitation program and the problem of trunk imbalance they are made to feel trouble to start walking after fracture.

The impact of hip fracture on health status is higher than anyone could expect in the Thai setting.

Even though the cost utility analysis of hip fracture in this study is lower than other, developed countries, it really has high impact on Thailand. The total cost was 50% of Thai National GDP per capita in 2008 (US\$ 8,400 from the CIA World Factbook, ([www.indexmundi.com](http://www.indexmundi.com))). Other reports varied from 30-75% of GDP per capita<sup>(10)</sup>. The total cost per QALY was US\$ 6,620.52, which reached 78.8% of Thai National GDP.

Limitations of this research were lack of pre-fracture state of health values, absence of control group for comparison, and no long-term follow-up. Cost of hip fracture might be underestimated due to access to medical care scheme. The present investigation was confined to only hip surgery patients who may give

higher state of health values than the general population. This study also depended on Thai TTO that could not directly estimate index values in unconscious and death states.

This report determined the high impact of hip fracture in terms of cost, quality of life and cost per QALY. Large scale, economic evaluation is obviously needed before developing and implementing a national policy for hip fracture prevention. Additional research is also required to explore how real, the benefit of prevention is.

#### Potential conflicts of interest

None.

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### การวิเคราะห์ต้นทุนอรรถประโยชน์ของภาวะกระดูกสะโพกหักจากกระดูกพรุนในคนไทย

วิวัฒน์ วอนะวิศิษฐ์, ภัทธวินัย วรรณารัตน์, ศันสนีย์ สวัสดิ์เรียวกุล, ชัชวาล เลิศบุษยานุกุล, บุญส่ง องค์พิพัฒน์กุล

ได้ทำการศึกษาผู้ป่วยกระดูกสะโพกหักจากโรคกระดูกพรุนในปี พ.ศ. 2551 เพื่อประเมินหาต้นทุนที่ใช้ในการรักษาผู้ป่วยเหล่านั้นในประเทศไทย ซึ่งเป็นประเทศที่กำลังพัฒนา โดยคำนวณจากต้นทุนทั้งทางตรงและทางอ้อมรวมทั้งประเมินคุณภาพชีวิตของผู้ป่วยหลังผ่าตัดเป็นเวลา 1 ปี โดยใช้แบบสอบถาม EQ5D แล้วแปลงเป็น time trade off ซึ่งได้ค่า cost/QALY โดยมีผู้ป่วยที่สามารถประเมินคุณภาพชีวิตได้ครบถ้วนจำนวน 42 คน มีอายุเฉลี่ย 75.6 ปี และเป็นเพศหญิงร้อยละ 71 ผู้ป่วยทั้งหมดได้รับการผ่าตัดเปลี่ยนข้อสะโพกเทียมหรือยึดตรึงด้วยโลหะยึดกระดูก ค่ามัธยฐานของต้นทุนทั้งหมดต่อปีเท่ากับ 126,319.50 บาท (4,201.6 US\$) ค่ามัธยฐาน QALY เท่ากับ 0.636 และ cost/QALY เท่ากับ 198,615.57 บาท (6,602.52 US\$) ค่าต้นทุนอรรถประโยชน์ของกระดูกสะโพกหักที่คำนวณได้จะต่ำกว่าในประเทศที่พัฒนาแล้ว เนื่องจากผู้ป่วยไทยจะมีญาติหรือคนในครอบครัวดูแลกันเอง และส่วนใหญ่ไม่ได้เสียค่าใช้จ่ายในช่วงฟื้นฟูสภาพร่างกาย อย่างไรก็ตามต้นทุนเหล่านี้สูงถึงร้อยละ 78.8 ของผลิตภัณฑ์มวลรวมประชาชาติ (GNP) ดังนั้นการป้องกันกระดูกสะโพกหักจึงเป็นนโยบายที่จำเป็นสำหรับทุกประเทศทั่วโลก

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