



Epidemiology of hip fractures in Thailand

Natthinee Charatcharoenwitthaya¹ · Hataikarn Nimitphong² · Lalita Wattanachanya³ · Thawee Songpatanasilp⁴ · Boonsong Ongphiphadhanakul² · Chaicharn Deerochanawong⁵ · Khemajira Karaketklang⁶

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Abstract

Summary This retrospective study examining hip fracture incidence, hip fracture trends, and the annual hospitalization costs for hip fractures in a population aged 50 years and older within the Universal Health Coverage System revealed that the incidence of hip fractures and the annual hospitalization costs for hip fractures increased significantly from 2013 to 2022.

Purpose To examine the annual incidence of hip fractures over 10 years (2013–2022), hip fracture trends, and the annual hospitalization costs for hip fractures in a population aged 50 years and older within the Universal Health Coverage System.

Methods A retrospective study was conducted. Hip fracture hospitalizations were identified using ICD-10. Data on the number of hip fracture hospitalizations, population aged ≥ 50 years, and hospitalization costs were obtained. The primary outcome was the annual incidence of hip fractures. The secondary outcomes were hip fracture incidence by 5-year age group, the annual hospitalization costs for hip fractures, and the number of hip fractures in 6 regions of Thailand.

Results The hip fracture incidence increased annually from 2013–2019 and then plateaued from 2019–2022, with the crude incidence (per 100,000 population) increasing from 112.7 in 2013 to 146.7 in 2019 and 146.9 in 2022. The age-standardized incidence (per 100,000 population) increased from 116.3 in 2013 to 145.1 in 2019 and remained at 140.7 in 2022. Increases in the crude incidence were observed in both sexes (34% in females and 21% in males; $p < 0.05$). The annual hospitalization costs for hip fractures increased 2.5-fold, from 17.3 million USD in 2013 to 42.8 million USD in 2022 ($p < 0.001$). The number of hip fractures increased in all six regions of Thailand across the 10-year study period.

Conclusion Osteoporotic hip fractures are a significant health concern in Thailand. The incidence and the annual hospitalization costs for hip fractures increased significantly from 2013 to 2022.

Keywords Osteoporosis · Hip fractures · Epidemiology · Incidence · Cost · Thailand

✉ Natthinee Charatcharoenwitthaya
natthineenc@gmail.com; natthineei@yahoo.com

Hataikarn Nimitphong
hataikarnn@hotmail.com

Lalita Wattanachanya
lalita_md@yahoo.com

Thawee Songpatanasilp
thaweeps@gmail.com

Boonsong Ongphiphadhanakul
boonsong.ong@mahidol.ac.th

Chaicharn Deerochanawong
Chaicharn_dee@hotmail.com

Khemajira Karaketklang
oy.kemajira@gmail.com

² Division of Endocrinology and Metabolism, Department of Medicine, Faculty of Medicine Ramathibodi Hospital, Mahidol University, 270 Rama VI Road, Thung Phaya Thai, Bangkok 10400, Ratchathewi, Thailand

³ Division of Endocrinology and Metabolism, Department of Medicine, Faculty of Medicine, Chulalongkorn University, 1873 Rama 4 Road, Bangkok 10330, Thailand

⁴ Department Orthopaedic Surgery, Phramongkutklao Hospital and College of Medicine, 315 Ratchawithi Road, Thung Phaya Thai, Bangkok 10400, Ratchathewi, Thailand

⁵ College of Medicine, Ministry of Public Health, Rajavithi Hospital, Rangsit University, Bangkok 10400, Thailand

⁶ Department of Medicine, Faculty of Medicine, Siriraj Hospital, Mahidol University, 2 Wanglang Road, Bangkok 10700, Bangkok-Noi, Thailand

¹ Division of Endocrinology and Metabolism, Department of Medicine, Faculty of Medicine, Thammasat University, 99/209 Pahonyothin Road, Pathumthani 12120, Thailand

Introduction

Osteoporotic hip fractures are a significant public health problem worldwide [1]. Epidemiological studies have demonstrated the burden of hip fractures, including increased morbidity, mortality, and healthcare costs [1–3]. However, this may be prevented with timely and appropriate osteoporosis management. Hip fracture rates and trends markedly vary across countries and study periods, with more than tenfold variation [4, 5]. Several factors may be associated with these differences, including genetics, ethnicity, socioeconomic characteristics, environmental factors, lifestyle factors, fall risk, life expectancy, and osteoporosis management [6]. Although several countries have reported decreased hip fracture rates [7–13], others have reported stable [14, 15] or even increased hip fracture rates [4, 16]. No previous studies have been conducted on hip fracture trends in Thailand. The country-specific epidemiology of hip fractures is essential for informing policymakers about the burden of osteoporosis within a country.

The Universal Health Coverage System was established in Thailand in 2002. This system covers approximately 70% of the Thai population and provides access to fundamental healthcare for patients with many diseases. However, it has some limitations for osteoporosis patients. Limited reimbursement for dual-energy X-ray absorptiometry (DXA) scanning and generic alendronate prescriptions before hip fracture may result in suboptimal management of osteoporosis in this population. This study aimed to examine the annual incidence of fragility hip fractures over 10 years from 2013 to 2022, 10-year hip fracture trends, and annual hospitalization costs for hip fractures in a population aged 50 years and older within the Universal Health Coverage System.

Methods

This retrospective study was conducted in a population aged 50 years and older within the Universal Health Coverage System. The inclusion criteria were age ≥ 50 years and hospitalization due to hip fracture between January 1, 2013, and December 31, 2022. Hip fracture hospitalizations were identified using the International Classification of Diseases, Tenth Edition (ICD-10) codes S72.0 (closed fracture of the neck of the femur), S72.1 (closed trochanteric fracture of the femur), and S72.2 (closed subtrochanteric fracture of the femur). The number of hip fracture hospitalizations, population aged ≥ 50 years, and the hospitalization costs for hip fractures (total direct costs) were

obtained from the National Health Security Office (NHSO) Database. All the data were extracted by senior staff from the NHSO Monitoring and Evaluation Department. The primary outcome was the crude, age-standardized, and age- and sex-standardized incidence of hip fractures. The secondary outcomes included crude incidence of hip fractures by 5-year age group (50–54, 55–59, 60–64, 65–69, 70–74, 75–79, and ≥ 80 years), crude incidence of hip fractures by 5-year age group and sex, annual hospitalization costs for hip fractures, and the number of hip fractures in six geographical regions of Thailand. This study was approved by the Human Research Ethics Committee of Thammasat University (Medicine).

Statistical analyses were performed using STATA 14.1. The annual incidence of hip fractures per 100,000 population was analyzed for the total population, females, males, and 5-year age groups (50–54, 55–59, 60–64, 65–69, 70–74, 75–79, and ≥ 80 years). Age adjustment was standardized to the 2013–2022 population data using a direct method by weighing the age-specific rates observed in a population by the proportion of each age group in a standard population. The 10-year trends of hip fracture hospitalizations, hip fracture incidence, hip fracture incidence by 5-year age group, hospitalization costs, hospitalization costs per fracture, and population size were analyzed using the Mann–Kendall test. The magnitudes of the trends were analyzed using Sen's slope estimator. The year-to-year variations in hip fracture incidence and differences in hip fracture incidence between adjacent 5-year age groups were analyzed using Poisson regression. A two-tailed P-value of < 0.05 was considered to indicate statistical significance for all tests performed.

Results

Study population and numbers of hip fracture hospitalizations

The annual numbers of individuals aged 50 years and older within the Universal Health Coverage System are shown in Fig. 1a and **Online Resource 1**. The population significantly increased by 29.1%, from 13,497,591 individuals in 2013 to 17,423,865 individuals in 2022 ($p < 0.001$). The increases were observed in both sexes, with a 29.8% increase in females and a 28.3% increase in males (both $p < 0.001$). There were 211,139 hip fracture hospitalizations across the 10-year study period. The annual numbers of hip fracture hospitalizations are shown in Fig. 1b. The number of hip fractures increased by 68.3% from 15,210 in 2013 to 25,595 in 2022 ($p < 0.001$). Increases were observed in both sexes [73.8% in females ($p < 0.001$) and 55.5% in males ($p < 0.001$)]. The annual numbers of hip fracture hospitalizations by 5-year age

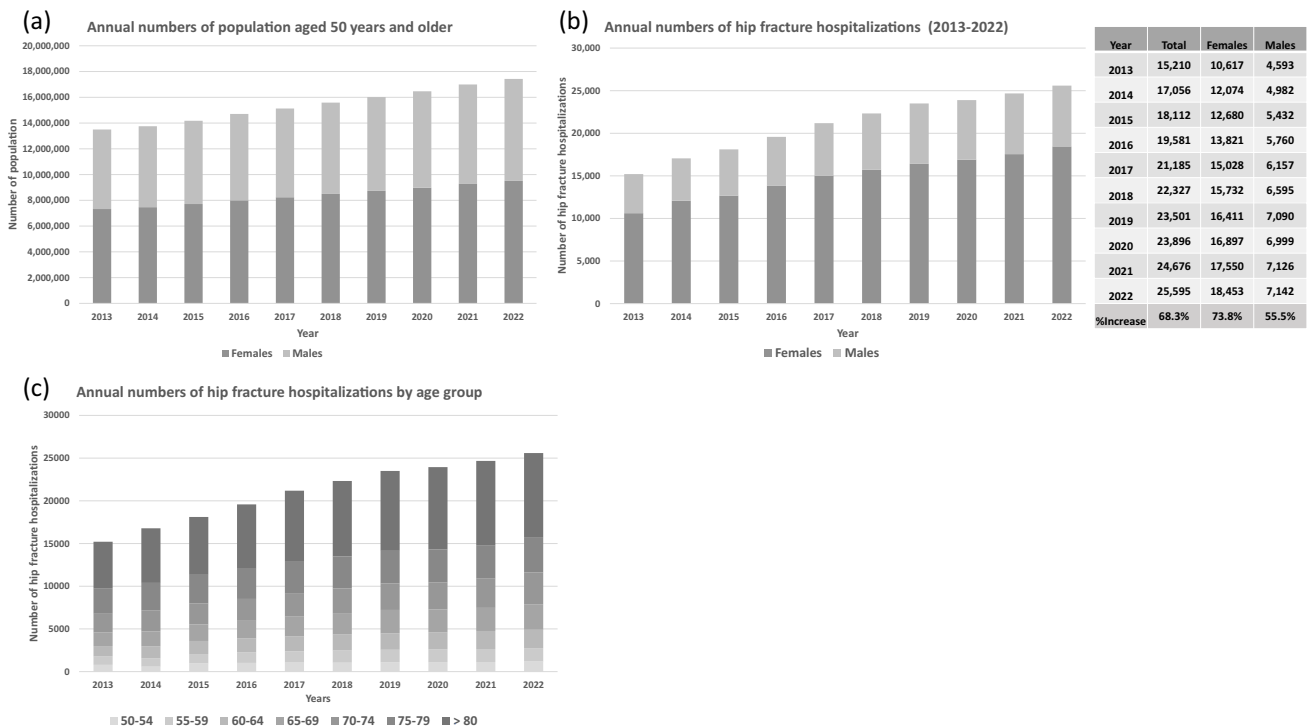


Fig. 1 (a) Annual numbers of individuals aged 50 years and older within the Universal Health Coverage System (b) Annual numbers of hip fracture hospitalizations (c) Annual numbers of hip fracture hospitalizations by 5-year age group

group are shown in Fig. 1c and **Online Resource 2**. The number of hip fractures increased with age, with the highest number in the ≥ 80 -year age group, and approximately 80% of hip fractures occurred in patients aged ≥ 65 years. Over the 10-year study period, the number of hip fractures significantly increased in all age groups, and increases were observed in both sexes.

The annual incidence of hip fractures from 2013 to 2022

The annual incidence of hip fractures from 2013 to 2022 is presented in Table 1 and Figs. 2a and 2b. The incidence of hip fractures increased annually from 2013 to 2019 and then plateaued from 2019 to 2022, with the crude incidence (per 100,000 population) increasing from 112.7 in 2013 to 146.7 in 2019 and remaining at 146.9 in 2022. The age-standardized incidence (per 100,000 population) increased from 116.3 in 2013 to 145.1 in 2019 and remained at 140.7 in 2022. Over the 10-year study period, the crude incidence increased by approximately 30% ($p < 0.001$, Sen’s slope = 3.48) in both sexes [34% in females ($p < 0.001$, Sen’s slope = 4.43) and 21% in males ($p = 0.01$, Sen’s slope = 2.23)]. The age-standardized and age- and sex-standardized incidence increased by approximately 21%

(both $p = 0.04$, Sen’s slope = 1.90 and 1.88, respectively). The female-to-male ratios were approximately 2:1 across the 10-year study period.

The annual incidence of hip fractures by the 5-year age group is presented in Table 2 and Figs. 2c and 2d. Over the 10-year study period, the incidence significantly increased in the 50–54-year, 55–59-year, 60–64-year, and 65–69-year age groups among the total population; in the 50–54-year, 55–59-year, 60–64-year, and 65–69-year, and ≥ 80 -year age groups among females; and in the 50–54-year, 55–59-year, and 60–64-year age groups among males. The incidence increased markedly with increasing age, with the lowest occurring in the 50–54-year age group (23.7–33.4 per 100,000 population) and the highest occurring in the ≥ 80 -year age group (510.0–665.0 per 100,000 population). In comparisons between adjacent 5-year age groups, hip fracture incidence significantly increased after the age of 55–59 years in females and after the age of 60–64 years in males, with steep increases after the age of 65–69 years in females and 70–74 year in males (Fig. 2d and **Online Resources 3–5**).

The annual hospitalization costs for hip fractures

The annual hospitalization costs for hip fractures are shown in Figs. 3a and 3b. The annual costs increased

Table 1 Annual incidence of hip fractures from 2013 to 2022

Year	Crude incidence of hip fractures (per 100,000 population)			Age-standardized incidence (per 100,000 population)			Age- and sex-standardized incidence (per 100,000 population)
	All	Females	Males	All	Females	Males	
2013	112.7	144.9	74.4	116.3	150.4	76.0	116.5
2014	124.0	161.6	79.3	128.0	167.3	81.3	128.1
2015	127.7	164.4	84.0	132.2	170.6	86.3	132.3
2016	133.1	172.8	85.9	136.6	177.5	87.7	136.6
2017	140.0	182.4	89.4	141.9	185.0	90.3	141.9
2018	143.2	185.2	93.0	143.6	185.8	93.2	143.6
2019	146.7	187.9	97.3	145.1	185.8	96.4	145.1
2020	145.1	188.2	93.5	141.7	183.4	91.8	141.7
2021	145.2	189.3	92.2	140.6	182.6	90.0	140.5
2022	146.9	194.1	90.2	140.7	185.0	87.5	140.6
% Increase over 10 years	30.4%	33.9%	20.9%	21%	23%	15%	20.7%
P-value	<0.001	<0.001	0.01	0.04	0.03	0.07	0.04
Sen's slope	3.48	4.43	2.23	1.90	2.56	1.75	1.88

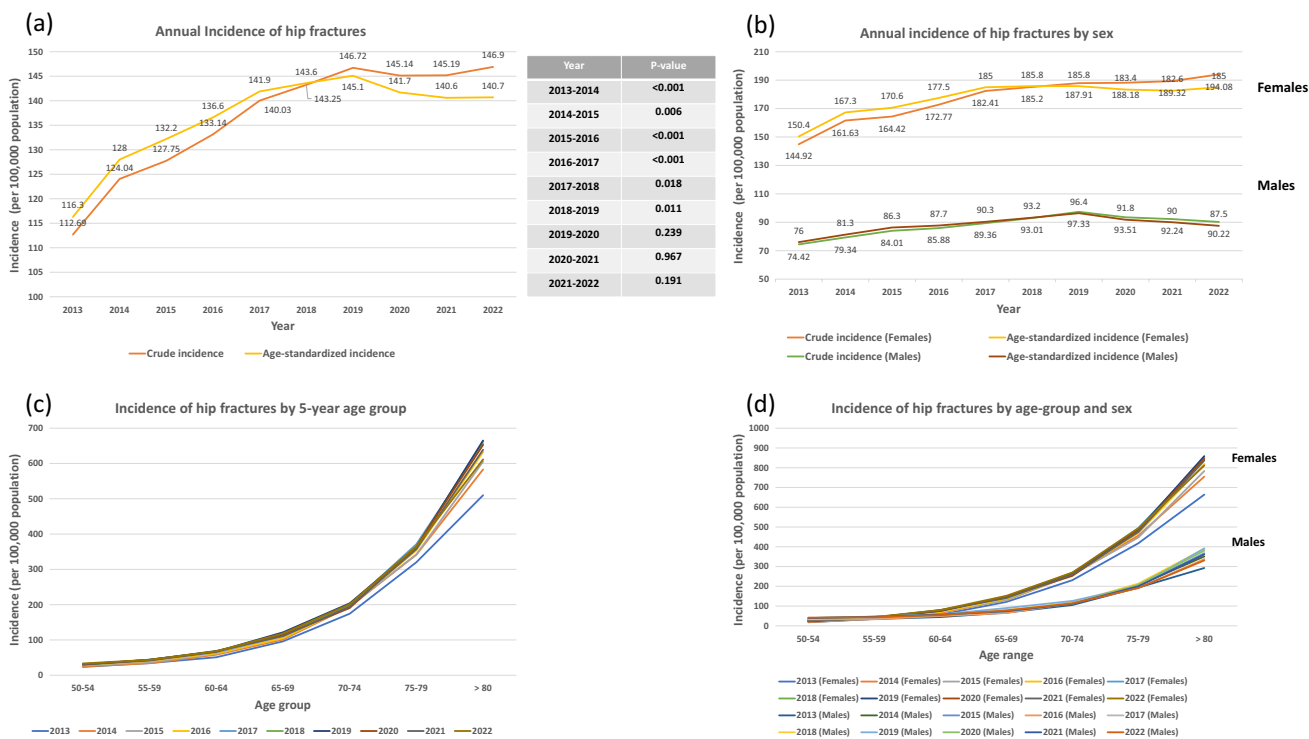


Fig. 2 (a) Annual incidence of hip fractures (Crude and age-standardized incidence) (b) Crude and age-standardized incidence by sex (c) Crude incidence by 5-year age group (d) Crude incidence by 5-year age group and sex

2.5-fold, from 627 million baht in 2013 to 1,550 million baht in 2022 (approximately 17.3 million USD in 2013 and 42.8 million USD in 2022) ($p < 0.001$). The costs per

hip fracture increased by 46.9% from 41,227 baht (95% CI: 40,485–41,969 baht) in 2013 to 60,568 baht (95% CI: 59,606–61,530 baht) in 2022 (approximately 1,139 USD

Table 2 Annual incidence of hip fractures by 5-year age group and sex

Age group (years)		Incidence of hip fracture (per 100,000 population)										% Change over 10 years
		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	
50–54	Total	23.7	25.0	27.8	28.8	29.6	29.1	30.5	31.4	31.4	33.4	40.7%*
	Females	18.0	18.3	22.7	22.9	24.1	23.6	22.5	24.4	24.8	26.2	46%*
	Males	30.1	32.3	33.4	35.3	35.6	35.1	39.3	39.1	38.6	41.2	37%*
55–59	Total	34.5	34.0	36.7	40.6	41.8	44.2	44.0	42.3	43.4	43.7	26.6%*
	Females	34.8	34.7	33.9	40.3	42.6	43.0	41.7	40.6	41.2	44.1	26.8%*
	Males	34.2	33.3	40.0	40.9	41.0	45.5	46.7	44.3	45.9	43.2	26.4%*
60–64	Total	50.9	58.1	61.0	61.6	64.80	67.8	67.1	67.6	69.0	67.8	33.3%*
	Females	56.4	65.4	71.3	69.3	75.0	78.2	75.4	77.2	79.7	79.6	40.9%*
	Males	44.4	49.5	48.8	52.5	52.6	55.5	57.4	56.1	56.4	54.1	21.8%*
65–69	Total	96.05	101.1	104.5	105.3	111.5	114.8	121.6	113.8	110.7	118.5	23.4%*
	Females	120.9	131.6	128.4	137.2	143.3	143.6	147.7	145.7	140.6	151.7	25.4%*
	Males	66.6	64.5	75.7	66.7	73.0	79.5	89.7	74.4	73.9	77.5	16.5%
70–74	Total	174.3	194.1	195.1	195.5	199.0	201.5	203.6	190.5	194.7	201.2	15.4%
	Females	230.7	258.8	258.9	257.6	264.9	269.3	264.7	252.5	259.6	269.2	16.7%
	Males	105.3	114.5	116.0	118.0	116.1	116.0	126.0	111.4	111.3	113.6	7.9%
75–79	Total	320.2	341.6	342.1	353.9	371.2	364.7	363.0	364.3	357.3	365.0	14.0%
	Females	417.6	456.4	446.9	469.5	494.6	479.0	485.7	481.7	474.7	493.4	18.1%
	Males	193.4	191.6	204.4	202.0	208.4	213.4	200.4	207.8	199.9	191.3	-1.0%
≥ 80	Total	510.0	583.0	605.5	632.6	655.4	662.1	665.0	652.7	639.1	611.5	19.9%
	Females	664.0	755.0	783.2	818.7	844.7	854.3	858.7	846.0	836.5	811.3	22.2%*
	Males	292.5	337.5	351.0	367.0	386.0	389.3	391.6	380.3	361.4	331.0	13.2%

*P < 0.05

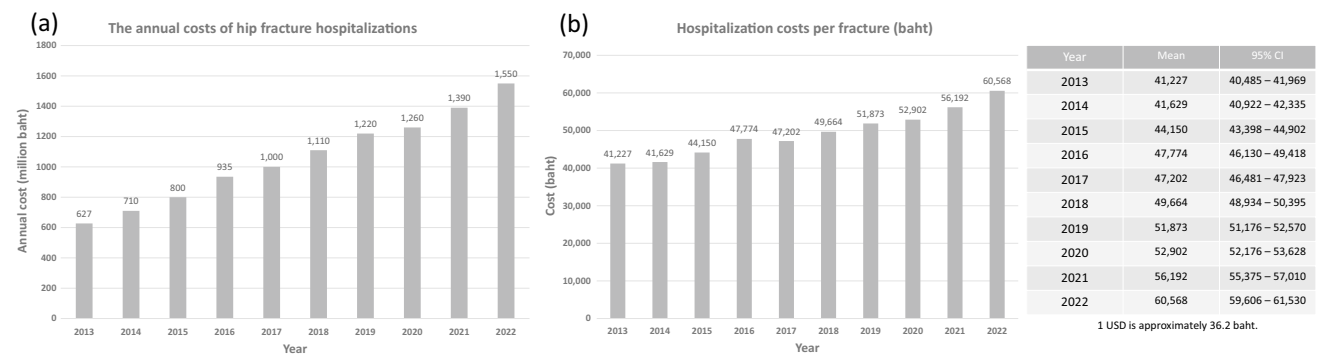


Fig. 3 (a) The annual hospitalization costs for hip fractures (b) Annual costs per hip fracture

(95% CI: 1,118–1,159 USD in 2013 and 1,673 USD (95%CI: 1,647–1,700 USD) in 2022) (p < 0.001).

The number of hip fractures in six geographical regions of Thailand

The number of hip fractures in six geographical regions of Thailand is presented in Table 3. The number of hip fractures was the highest in the Central region, followed by the

Northeastern, the Northern, the Southern, the Eastern, and the Western regions. The number of hip fractures increased by 36–86% in all six regions across the 10-year study period. The number of hip fractures in the 77 provinces of Thailand across the 10-year study period is presented in **Online Resource 6**. The provinces with the third-highest number of hip fractures from 2014 to 2022 were Bangkok, Chiangmai, and Nakhon Ratchasima. Over the 10-year study period, the number of hip fractures increased by 20–271%

Table 3 The number of hip fractures in six geographical regions of Thailand

Year	Number of hip fractures in six regions					
	Central	Northeastern	Northern	Southern	Eastern	Western
2013	4,783	3,507	3,414	1,512	1,095	899
2014	5,594	3,971	3,549	1,709	1,237	996
2015	5,779	4,157	3,818	1,974	1,375	1,009
2016	6,475	4,430	4,061	2,107	1,378	1,129
2017	6,896	5,075	4,127	2,325	1,616	1,146
2018	7,396	5,396	4,218	2,416	1,652	1,249
2019	7,661	5,703	4,602	2,543	1,677	1,315
2020	7,918	5,842	4,469	2,576	1,781	1,310
2021	8,117	6,252	4,618	2,527	1,787	1,375
2022	8,518	6,537	4,638	2,545	1,966	1,391
% Increase over 10 years	78%	86%	36%	68%	79%	55%

in all 77 provinces, with a more than twofold increase in 13 provinces, including Nonthaburi, Petchabun, Saraburi, Ayutthaya, Pathum Thani, Chaiyaphum, Kalasin, Yasothon, Nong Bua Lamphu, Beung Kan, Amnat Charoen, Sa Kaeo, and Trat.

Discussion

The present study, which included more than 200,000 hip fracture hospitalizations between 2013 and 2022 in a population aged 50 years and older within the Universal Health Coverage System of Thailand, demonstrated significant increases in the number of hip fracture hospitalizations, hip fracture incidence, and hospitalization costs for hip fractures across the 10-year study period. The increases in the crude incidence of hip fractures were demonstrated in both sexes and in the 50–54-year, 55–59-year, 60–64-year, and 65–69-year age groups among the total population; 50–54-year, 55–59-year, 60–64-year, and 65–69-year, and ≥ 80 -year age groups among females; and in the 50–54-year, 55–59-year, and 60–64-year age groups among males. The incidence of hip fractures increased exponentially with age, particularly after the age of 65–69 years in females and after the age of 70–74 years in males.

Interestingly, the incidence of hip fractures increased annually from 2013 to 2019 and then plateaued from 2019 to 2022. This plateau may have been associated with the coronavirus disease 2019 (COVID-19) pandemic, which caused increasing mortality among the aging population and lifestyle changes that may have decreased the risk of hip fractures during this period. The plateau is unlikely to be due to osteoporosis management because of the limited reimbursement of DXA scanning and generic alendronate prescriptions before hip fracture for the population within the Universal Health Coverage System and the limited

number of physicians taking care of osteoporosis patients in Thailand. The increases in the number and crude incidence of hip fractures across the 10-year study period in both sexes emphasize the urgent need for timely osteoporosis management to prevent fragility hip fractures in Thailand. Regarding incidence by 5-year age group, it appeared that the incidence was relatively stable for the older age groups, except for females aged ≥ 80 years, and increased for the younger age groups. The relatively unchanged incidence in older age groups suggests that hip fractures have remained an unsolved health problem for over ten years. In addition, the increased incidence in the younger age groups suggests a growing problem that needs to be addressed. The graphs of hip fracture incidence by 5-year age group were similar across the 10-year study period. The hip fracture incidence began to increase after the age of 55–59 years in females and after the age of 60–64 years in males, with steep increases after the age of 65–69 years in females and 70–74 years in males. These results suggest that fracture risk assessments should be performed at approximately 55 years of age in females and 60 years of age in males. Osteoporosis management should be initiated in a timely manner to prevent fragility hip fractures. The Thai Osteoporosis Foundation (TOPF) Clinical Practice Guideline on the Diagnosis and Management of Osteoporosis 2021 recommends bone mineral density (BMD) measurements in females aged 65 years and males aged 70 years without clinical risk factors [17]. The evaluation of BMD at a younger age may be beneficial for primary hip fracture prevention. Further economic analyses on the cost-effectiveness of BMD evaluation at younger ages in the Thai population are needed.

The number of hip fractures increased in all six geographical regions and 77 provinces in Thailand over the 10-year study period. These results suggest an urgent need for hip fracture prevention plans for the country, particularly in provinces with high hip fracture numbers or increasing rates.

There have been no nationwide studies on the incidence of hip fractures in Thailand. Previous studies were conducted in only one province and may not accurately represent the hip fracture situation in Thailand. Studies in Chiangmai Province in 1997–1998 [18] and 2006–2007 [19] revealed increases in the crude incidence of hip fractures (from 151.9 per 100,00 in 1997 to 181.0 per 100,000 in 2006) and age-standardized incidence (from 192.9 per 100,000 in 1997 to 253.3 per 100,000 in 2006) [18, 19]. Another study in Nan Province in 2015–2017 revealed that the crude incidence of hip fractures was 211.6, 214.9, and 238.5 per 100,000 person-years, respectively [20]. The reported incidence in the Chiangmai and Nan Provinces was higher than the incidence reported in this study. These differences may be due to differences in the characteristics, fracture risks, and fall risks among the study populations and different study periods. Geographic variations in hip fracture incidences within countries have been reported in several countries [21–23]. Further studies on hip fracture incidence in the 77 provinces of Thailand are required to address the burden of hip fractures in each province and to develop local strategies for hip fracture prevention in each area.

Compared to those in other Asian countries and territories, the hip fracture incidence in Thailand was similar to that in China [14] but lower than those in Japan [24], Taiwan [25], Singapore, Hong Kong, and South Korea [4]. The greater proportion of the aging population, impact of urbanization, and differences in socioeconomic, environmental, and lifestyle factors may contribute to higher hip fracture incidence in these countries and territories. Compared to those in non-Asian countries, the hip fracture incidence in Thailand was similar to those in the United Kingdom and the Netherlands but lower than those in Australia, New Zealand, the United States of America, and several countries in Northern and Western Europe, including Denmark, France, Finland, Italy, Germany, and Spain [4]. Geographic and ethnic disparities in osteoporotic fractures and hip fractures have been reported [6, 26]. In contrast to the increasing trend of hip fractures in Thailand, a decreasing trend has been observed in several countries and territories [4, 27]. The earliest studies conducted in the United States, Canada, Northern Europe, Oceania, Hong Kong, and Taiwan demonstrated high and increasing age-adjusted rates of hip fractures, which then plateaued or began to decline. The earliest declines were observed in the United Kingdom in the late 1970s, North America in the mid-1980s, and Scandinavia in the 1990s [27]. A recent study on the global epidemiology of hip fractures demonstrated a decreasing trend in Singapore, Hong Kong, Taiwan, New Zealand, Denmark, Finland, the United Kingdom, Italy, Spain, the United States of America, and Canada [4]. Improved post-hip fracture care that reduces the rate of second hip fractures; improved

lifestyle habits (such as quitting smoking and reducing alcohol consumption); the implementation of fall prevention programs; and increased use of calcium, vitamin D, and osteoporosis drugs may contribute to the declining trends in these countries and territories [4, 27].

Hip fractures are considered the most expensive type of osteoporotic fracture. The annual costs of hospitalizations for hip fractures in Thailand were high and significantly increased by 2.5-fold across the 10-year study period. In contrast, osteoporosis drug costs have decreased, and generic alendronates are inexpensive. Therefore, the evaluation and management of osteoporosis to prevent fragility hip fractures should be cost-effective or cost-saving in Thailand, as in other countries [28–30], and should be included in Thailand's national health policy.

The strength of the present study is the large sample size, which included approximately 74% of the Thai population aged 50 years and older. In addition, the study period of 10 years allowed for the assessment of trends in the number of hip fractures, the incidence, and hospitalization costs. A limitation of this study is its retrospective design. The National Health Security Office Database was initially established for administrative and reimbursement purposes rather than research. Therefore, there may be issues related to data completeness.

Conclusions

Osteoporotic hip fractures are a significant health problem in Thailand. The incidence and the annual hospitalization costs for hip fractures increased significantly from 2013 to 2022. The evaluation and management of osteoporosis to prevent fragility hip fractures should be included in Thailand's national health policy.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s00198-024-07140-2>.

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Author contributions All authors were involved in data acquisition, analysis, or interpretation and in drafting the article or revising it critically for important intellectual content. All authors approved the final version to be submitted for publication. Study conception and design: NC, HN, LW, TS, BO, CD. Acquisition of data: NC, KK. Analysis and interpretation of data: NC, HN, LW, TS, BO, CD, and KK take responsibility for the integrity of the data analysis. The corresponding author attests that all listed authors meet the authorship criteria and that no others meeting the criteria have been omitted.

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Data availability The data that support the findings of this study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval The study was approved by the Human Research Ethics Committee of Thammasat University (Medicine) and performed in accordance with the ethical standards of the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. For this type of study, formal consent is not required.

Conflict of interest Natthinee Charatcharoenwitthaya, Hataikarn Nim-itphong, Lalita Wattanachanya, Thawee Songpatanasilp, Boonsong Ongphiphadhanakul, Chaicharn Deerochanawong, and Khemajira Karakatklang declare that they have no conflicts of interest.

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