RESEARCH ARTICLE

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Economic Burden of Breast Cancer on Patients and their Caregivers in a Regional Health Setting in Thailand: A Prevalence-Based Cost-of-Illness Study

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Abstract

This prevalence-based cost-of-illness study aimed to examine the cost of illness for breast cancer patients and their caregivers in Health Region 9, Thailand. **Methods:** Data were collected from 404 participants, comprising 202 pairs of breast cancer patients and their caregivers across Health Region 9 during six months from September 2024 to February 2025. Participants were recruited by the researcher, going to 10 areas in the region and personally visiting and obtaining formal permission from the appropriate health authorities. A questionnaire was developed and distributed through the primary care coordinators at the local health facilities, who served as intermediaries to explain the research objectives to participants and to coordinate data-collection schedules. **Results:** All the patients were female with a mean age of 56.13 years. The majority of the caregivers were also female. Most caregivers were related to the patients, with the majority being the children or spouses. The average total cost of illness was USD 165.11 (95%CI: 119.44–210.78). Regarding the indirect costs, the average total costs for the patients and their caregivers were USD 80.10, with the highest proportion (at 48.52% of the total costs) accounted for by lost income due to leaving work due to sickness (USD 47.92 per month). **Conclusions:** This study shows that the economic impact of breast cancer treatment in a regional setting in Thailand was primarily due to productivity losses from missed work, which represents an indirect cost rather than a direct medical expense.

Keywords: Breast cancer- direct medical cost- direct non-medical cost- indirect cost

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Introduction

Breast cancer is a major health concern for women worldwide. Currently, it has the highest cancer incidence rate among Thai women, which continues to increase every year, being a significant cause of death [1]. According to a 2021 statistical report from the National Cancer Institute, Department of Medical Services, and Ministry of Public Health in Thailand, breast cancer ranks first among all cancers in Thailand, accounting for 37.9% of cancers in women, with the incidence rate showing a continuous upward trend [2].

The cost of illness (COI) is an assessment of the economic burden associated with specific diseases from a societal perspective, patient perspective, and considering the healthcare system [3]. The patient perspective comprises three primary components: 1) direct medical costs, which refer to the costs of healthcare services, medications, medical devices, etc. by patient; 2) direct non-medical costs, which refer to transportation costs to appointments/treatment centers, accommodation, caregiving expenses, etc.; and 3) indirect costs, which refer to e.g., productivity losses from missed work due to morbidity or premature mortality [4]. Understanding the COI in cancer research is particularly important for healthcare resource allocation and policy development, and moreover, for understanding the financial barriers to accessing healthcare [5].

In the context of breast cancer, COI assessment can be particularly complex due to the disease's chronic nature, multiple treatment phases, and substantial caregiver involvement. Previous international studies have presented variations in COI patterns depending on the healthcare system structure, health insurance coverage

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in each country, and socioeconomic context. For instance, studies from high-income countries typically report direct medical costs as being the main burden, while the limited evidence available from low-middle income countries suggests they have different cost distributions [6-8].

International COI studies have also reported substantial geographic variations in breast cancer economic burden. Significant costs have been reported in high-income countries, with a US study documenting average monthly costs of USD 21,908 [4]. A European study reported stage-specific total costs of USD 1,963,560, with medications representing the highest expense category [4]. A study from Asia reported a cost of only USD 975 in Vietnam for a 5-year treatment course [5], representing substantially lower absolute costs compared to the other studies, but potentially a high relative burden given the income disparities in the different countries. However, these international findings may not apply to Thailand and its healthcare context, which is characterized by universal health coverage, distinct healthcare delivery systems, and specific socioeconomic patterns. Interestingly, and to the best of our knowledge, no comprehensive COI study has yet been conducted among breast cancer patients in Thailand, particularly in regional healthcare settings, where the majority of the population receives healthcare.

Health Region 9 in Thailand covers 4 provinces (Nakhon Ratchasima, Chaiyaphum, Buriram, and Surin), and is home to 6.7 million residents and has a complete healthcare infrastructure. It represents an ideal setting for comprehensive COI assessment in Thailand's regional context. This study addresses a critical knowledge gap by providing the first comprehensive cost-of-illness estimates for breast cancer patients and caregivers in a universal health coverage system. It is anticipated that the findings will inform regional resource allocation and support national health policy development, and contribute to international evidence on the economics of cancer and its treatment. Specifically, this study aimed to quantify the comprehensive costs of breast cancer treatment, identify the primary cost drivers, and provide evidence-based recommendations for financial protection mechanisms.

Materials and Methods

This study was a prevalence-based cost-of-illness study from a patient perspective. Quantitative data were collected using questionnaires to assess the out-of-pocket direct medical, direct non-medical, and indirect costs of breast cancer patients and their caregivers in Health Region 9, which consists of the provinces of Nakhon Ratchasima, Chaiyaphum, Buriram, and Surin, of Thailand. It takes care of a population of over 6.7 million people in the area. It has 90 hospitals at all levels, including 3 regional hospitals, 2 large general hospitals, 5 general hospitals, and 80 community hospitals. There are 969 primary care units, 953 sub-district health promotion hospitals, 16 community health promotion centers, and 5 public health academic centers. There are a total of 38,118 public health personnel employed, including 2,122 doctors, 552 dentists, 916 pharmacists, 11,372 nurses, and 7,751 other professionals.

Study participants

Data were collected from 404 participants, comprising 202 pairs of breast cancer patients and their primary caregivers who met the following criteria: (1) the patients were breast cancer patients who had received services in Health Region 9 between September 2024 and February 2025; and (2) both the patients and their caregivers were willing to participate in the research project.

The sample size was calculated based on the main project aim, which involved a cost-of-illness study and factor correlation analysis using the formula of Hsieh et al. [6], with proportional values taken from Farah A. Moustafa et al., who examined factors associated with missed dermatology appointments. From the initial sample size calculation, it was found that the required sample size (n) was 81.82. The researcher selected $\rho = 0.60$ as the minimum sample size for the study, and then determined. The variance inflation factor (VIF). The VIF of independent variables equals 1/tolerance, with values ranging from 1 to ∞. If the VIF value is high, the independent variable has a strong relationship with other independent variables. If the VIF value is very low or close to 1, it indicates that each variable has very little relationship with other variables. If the VIF is greater than 10, it means there is evidence of a strong relationship [7]. Here, it was found that the (VIF) was 2.50, which indicated that the relationship between each variable and the other variables was at an acceptable level. Finally, the adjusted sample size was determined to be 201.05, or approximately 202 patients.

The study population consisted of breast cancer patients who received treatment in hospitals in Health Region 9 and seamless care with the sub-district health facilities in the 4 provinces, which here comprised 10 districts: Nakhon Ratchasima Province: Mueang Nakhon Ratchasima, Pak Thong Chai, Prathai and Non Sung district; Chaiyaphum Province: Mueang Chaiyaphum and Khon Sawan district; Buriram Province: Mueang Buriram, Na Pho district; and Surin Province: Mueang Surin and Tha Tum district. The researcher delivered the questionnaires personally, together with a letter requesting permission to collect data for research, to the district public health offices and sub-district health promotion hospitals in Health Region 9, along with providing a list of the sample groups in each district. The questionnaires were distributed to the 202 sample groups via the persons in charge of the primary care and home visits in the sub-district health promotion hospitals to coordinate with the sample groups. Also, the purpose of the research was explained, and an appointment was made for a date and time to return the questionnaires within the specified time frame. The researcher also provided pre-addressed sealed envelopes so that the sample groups could conveniently return the questionnaires. When the questionnaires were completed, they were sent directly to the researcher where the dependent variable is scheduled service attendance.

Data collection

To recruit participants, the researcher personally visited the facilities in all 10 areas in the region to obtain formal permission from the appropriate health authorities.

Questionnaire distribution was facilitated through the primary care coordinators at the local health facilities, who served as intermediaries to explain the research objectives to the participants and to coordinate the data-collection schedules. To ensure efficient and secure data return, the researcher provided pre-addressed sealed envelopes to allow the participants to conveniently mail their completed questionnaires directly back for analysis. The data was collected between September 2024 and February 2025.

Instruments

In this research study, the data-collection tool was a set of questionnaires. The questionnaires were designed to be consistent with each variable in the cost of illness research conceptual framework, validated by experts and researchers' team, consisting of two sets of questions, as per the following.

Set 1: Personal characteristics questionnaire on the illness costs of breast cancer patients and their caregivers in Health Region 9 (for patients), as follows: Part 1: Questionnaire covering the personal characteristics of the breast cancer patients. Part 2 Questionnaire about the medical costs of breast cancer patients in Health Region 9, with questions on: 1) Number of caregivers accompanying them for treatment; 2) Location of their residence (district and province); 3) Mode of transportation from home to hospital; 4) Round-trip transportation costs; 5) Accommodation expenses; 6) Food expenses; 7) Number of treatment visits; and 8) Frequency of treatment visits. The questions were in both closed-ended formats with multiple-choice answers and open-ended formats, whereby respondents could fill in the blanks according to their actual information. Part 3 Questionnaire about the indirect costs incurred by breast cancer patients in Health Region 9, with questions on: 1) Income loss when receiving treatment services; 2) Income loss when ill, and 3) Income loss when taking time off work. The questions were in both a closed-ended format with multiple-choice answers and an open-ended format, whereby respondents could fill in the blanks according to their actual information.

Set 2: Personal characteristics questionnaire on the indirect costs of caregivers to breast cancer patients receiving treatment in Health Region 9 (For Primary Caregivers), as follows: Part 1: Questionnaire covering the personal characteristics of the primary caregivers. Part 2 Questionnaire about the indirect costs incurred by the primary caregivers of breast cancer patients receiving treatment in Health Region 9, with question covering: 1) Whether accompanying the patient to the hospital for this service resulted in any income loss from taking time off work; 2) If so, how much income was lost from taking time off work to accompany the patient to the hospital for this service; 3) Besides taking time off work to accompany the patient to the hospital, whether they took time off work to care for the patient at home; 4) How many times per week did they take time off work to care for the patient at home; and 5) How much income did they lose from taking time off work to care for the patient at home. The questions were in an open-ended format, whereby respondents could fill in the blanks according to their actual information.

All the costs were collected in the questionnaire sets 1 and 2 in Thai Baht (THB), and were later converted into USD at an exchange rate of approximately 32.54 THB to 1 USD as of 28 February 2025 [8].

Statistical analysis

For describing the personal characteristics, data were analyzed using descriptive statistics. For the categorical data, the frequency and percentage were calculated. For the continuous data, the mean with the standard deviation or median with minimum and maximum values were used. The costs for breast cancer patients and their caregivers were reported as the mean with the 95% confidence interval (CI) estimated using the bootstrap method, as well as median with minimum and maximum values. All the statistical analyses were performed using Stata version 18 (StataCorp, College Station, TX, USA)

Results

Personal characteristics of breast cancer patients and their caregivers in Health Region 9

From the study of 202 breast cancer patients in Health Region 9, it was found that most patients were female in the age range of 50–59 years old (mean age of 56.13 years old), with an average monthly income of USD 243.47. Most had no underlying diseases, but among those with underlying conditions, hypertension and diabetes were the main conditions, and the majority had stage 2–3 breast cancer, with an average illness duration of 5.32 years, as shown in Table 1.

Personal characteristics of the breast cancer patients' caregivers in Health Region 9

The caregiver profiles in Health Region 9 reflected the family-centered cancer care support, which directly influences the treatment accessibility and economic burden. Most caregivers were female (53.47%), with an average age of 45 years old. They worked primarily as merchants and business owners, indicating they had some economic capacity to support treatment while maintaining flexibility for meeting their caregiving responsibilities. The majority of the primary caregivers were the children (41.09%) and spouses (35.64%) of the patients, as shown in Table 2.

Costs of illness of the breast cancer patients and their caregivers in Health Region 9

The costs of illness for breast cancer patients and their caregivers in Health Region 9, which reflect the economic burden they incurred, were as follows. For patients, their out-of-pocket direct medical expenses beyond direct healthcare coverage demonstrated considerable variability, with an average cost of USD 22.87 and substantial variance reaching as high as USD 3,073.05. The patients' average transportation costs were USD 20.50, while food costs were USD 17.94, with total average direct non-medical costs of USD 62.76. The major indirect cost was income loss, with patients losing an average of USD 21.42 per visit and a reduction in monthly income due to illness

Table 1. Characteristics of the Breast Cancer Patients in Health Region 9 Included in the Study (n=202)

Characteristics	Frequency	Percentage
Age (years)		
40–49	67	33.17
50–59	71	35.15
60 and above	64	31.68
(Mean = 56.13, S.D. = 10.06, Median = 55, Minimum = 40, Maximum = 87)		
Monthly income		
Less than USD 153.66	66	32.67
USD 153.66 and above	136	67.33
(Mean = 243.42 , S.D. = 229.43 , Median = 6,500, Minimum = 0 , Maximum = 1,536.53)		
History of chronic disease		
Hypertension	56	27.72
Diabetes	54	26.73
Heart disease	15	7.43
No chronic disease	106	52.48
Other	13	6.44
Stages of the disease		
Stage 1	32	15.84
Stage 2	65	32.18
Stage 3	62	30.69
Stage 4	43	21.29
Duration of illness		
Less than 5 years	105	51.98
5 years and above	97	48.02
(Mean = 5.32, S.D. = 4.24, Median = 4.05, Minimum = 3 Month, Maximum = 16 years)		

Table 2. Characteristics of the Caregivers in Health Region 9 (n = 202)

Characteristics	Frequency	Percentage
Sex		
Male	94	46.53
Female	108	53.47
Age (years)		
Under 35	48	23.76
35 and above	154	76.24
(Mean = 45.19 , S.D. = 12.31, Median = 47, Minimum = 18, Maximum = 70)		
Occupation		
Not working	10	4.95
Retired	2	0.99
Merchants /Business owner	78	38.61
Farmer	53	26.24
General employment	33	16.34
Government employee	17	8.42
Private employee	4	1.98
Other	5	2.48
Relationship of caregiver to breast cancer patient		
Father/Mother	7	3.47
Husband/Wife	72	35.64
Child	83	41.09
Other relative	36	17.82
Other	4	1.98

averaging USD 47.92, and total average indirect costs of USD 80.10. For caregivers, the average income loss from taking time off work was USD 17.91 per visit, and home care expenses were USD 4.34 per day. When combining the patient and caregiver costs, the total average cost was USD 165.11, reflecting the economic burden that families must bear due to breast cancer illness, as shown in Table 3.

Direct costs of breast cancer patients in Health Region 9

In examining the direct non-medical costs of breast cancer patients in Health Region 9, the cost for the patient and caregiver's shared accommodation (when necessary) was also considered, and it was found that the majority of patients (96.53%) spent less than USD 15.37 per time (THB 500), while only 3.47% spent USD 15.37 or more, and the mean cost was USD 1.45. Regarding the total cost for food, most patients (76.73%) spent less than USD 15.37 per visit on food for both the patient and caregiver combined, while 23.27% spent USD 15.37 or more. The mean food cost was significantly higher at USD 17.94. In terms of additional medical expenses, a large majority (91.09%) of patients paid less than USD 15.37 in additional medical expenses beyond what they received through their insurance or medical support rights, while 8.91% paid USD 15.37 or more, and the mean additional medical cost was USD 22.87. The costs for round-trip transportation to appointments and treatment centers were more evenly distributed, with 68.81% spending less than USD 30.73 and 31.19% spending USD 30.73 or more. The mean transportation cost was USD 20.50 (S.D. = 11.67), as detailed in Table 4.

Indirect costs of breast cancer patients in Health Region 9

In examining the indirect costs of the breast cancer patients in Health Region 9, it was found that most patients (69.31%) experienced minimal income loss of less than USD 15.37 per treatment visit, though 30.69% faced higher losses, with a mean of USD 10.76 per visit. Employment consequences varied considerably, with 61.39% reporting no income loss from work disruption, while among those affected, 31.19% suffered losses due to work stoppage and 7.43% lost income from illness-necessitated resignation. In examining illness-specific income loss per visit, the vast majority (90.10%) lost less than USD 15.37, but 9.90% experienced losses of USD 17.37 or more, with a mean loss of USD 21.42, and extreme variation reflected in the maximum loss of USD 1,536.53. The impact on employment duration showed that 92.57% faced unemployment periods of under one year, with a mean duration of 0.31 years (3.7 months), while 7.43% experienced longer periods extending up to 12 years maximum. Pre-departure monthly income analysis indicated that 90.10% earned less than USD 122.92 before leaving work due to illness, with a mean income of USD 47.92 and a maximum of USD 267 monthly, as detailed

Table 3. Costs of Illness of Breast Cancer Patients and Their Caregivers in Health Region 9 (n = 202)

Costs	Mean	SD	95% CI	Median	Min	Max	%
Patients (n = 202), Costs in USD							
1. Direct medical patient costs							
Direct medical expenses paid by the patient	22.87	222.88	6.98–52.72	0	0	3,073.05	13.85
2. Direct non-medical patient costs							
Round-trip transportation	20.5	11.67	18.93–22.06	15.37	0	61.46	12.41
Accommodation costs	1.45	6.96	0.49–2.40	0	0	61.46	0.87
Food costs for caregiver	17.94	25.28	14.45–21.56	10.76	3.07	276.55	10.87
Total direct medical costs (1+2)	62.76	232.1	32.51–93.01	36.87	0	3,120.13	38
3. Indirect patient's costs							
Amount of lost income due to sick leave per time	10.76	13.25	8.98–12.59	9.22	0	64.53	6.53
Amount of lost income due to sick leave per time	21.42	110.54	6.29–36.53	0	0	1,229.05	12.98
Income received before leaving work due to sickness/month	47.92	214.25	21.61–74.25	0	0	1,536.53	29.02
Total indirect costs	80.1	244.52	46.41–113.82	14.6	0	1,859.61	48.52
Caregivers costs/time (n=202)							
Amount of lost income from work stoppage (per time)	17.91	17.67	15.49–20.33	15.37	0	61.46	10.84
Amount of time taken off work to care for patients at home (per day)	4.34	13.08	2.59–6.10	0	0	92.19	2.63
Total (patients and caregivers)	165.11	315.25	119.44–210.78	74.67	6.15	3,120.13	100

Note: Converted from THB to USD using the exchange rate: 32.54 THB = 1 USD.

in Table 5.

Discussion

The total costs of illness for breast cancer were on average USD 165.11, which could be broken down into three parts: direct medical costs, direct non-medical costs, and indirect costs.

Direct medical costs

Out-of-pocket treatment expenses beyond health coverage were mostly less than USD 15.37 (91.09%), with an average of USD 22.87 per visit, a minimum of USD 0, and a maximum of USD 3,073.05 per visit. This may be due to Thailand's health insurance system, which provides excellent coverage for cancer treatment, including through the Universal Health Coverage scheme, Social Security, and Civil Servant Medical Benefits. This aligns with Ko et al.'s [9] analysis of the direct costs affecting patients' financial situations, including medical expenses (out-of-pocket and co-payments) and non-treatment costs (travel and childcare). This also aligns with Coumoundouros

Table 4. Direct Costs of Breast Cancer Patients in Health Region 9 (n = 202)

Direct costs	Frequency	Percentage
Cost for patient and caregiver's shared accommodation		
Less than USD 15.37 per time	195	96.53
USD 15.37 or more per time	7	3.47
(Mean = 1.45, S.D. = 6.96, Median = 0, Minimum = 0, Maximum = 61.46)		
Total cost for food for patient and caregiver		
Less than USD 15.37 per time	155	76.73
USD 15.37 or more per time	47	23.27
(Mean = 17.94, S.D. = 25.28, Median = 10.76, Minimum = 3.07, Maximum = 61.46)		
Medical expenses paid by the patient in addition to those received from their medical rights/insurance		
Less than USD 15.37 per time	184	91.09
USD 15.37 or more per time	18	8.91
(Mean = 22.87, S.D. = 222.88, Median = 0, Minimum = 0, Maximum = 3,073.05)		
Round-trip transportation		
Less than USD 30.73	139	68.81
USD 30.73 or more per time	63	31.19
(Mean = 20.50, S.D. = 11.67, Median = 15.37, Minimum = 0, Maximum = 61.46)		

Note: Converted from THB to USD using the exchange rate: 32.54 THB = 1 USD.

Table 5. Indirect Costs of Breast Cancer Patients in Health Region 9 (n = 202)

Indirect costs	Frequency	Percentage
Amount of lost income from work stoppage per time		
Less than USD 15.37	140	69.31
USD 15.37 or more per time	62	30.69
(Mean = 10.76, S.D. = 13.25, Median = 9.22, Minimum = 0, Maximum = 92.19)		
Lost income from work stoppage or resignation		
No lost income	124	61.39
Lost income from work stoppage due to sickness	63	31.19
Lost income from resignation due to sickness	15	7.43
Amount of income lost due to illness per time		
Less than USD 15.37	182	90.1
USD 15.37 or more per time	20	9.9
(Mean = 21.42, S.D. = 110.54, Median = 0, Minimum = 0, Maximum =1,536.53)		
Number of years of employment due to illness		
Less than one year	187	92.57
One year or more	15	7.43
(Mean = 0.31, S.D. = 1.35, Median = 0, Minimum = 0, Maximum = 12)		
Income you received before leaving work due to illness/month		
Less than USD 122.92 per month	182	90.1
USD 122.92 or more per month	20	9.9
(Mean = 47.92, S.D. = 185.23, Median = 0, Minimum = 1.14, Maximum = 2.67)		

Note: Converted from THB to USD using the exchange rate: 32.54 THB = 1 USD.

et al.'s study [10], which found that informal cancer caregivers faced significant direct costs from out-of-pocket expenses, lost opportunity costs from their caregiving time, and lost employment income. Care time was the largest cost burden, averaging USD 2,877–4,809 per month, with the highest costs arising during palliative care. This aligns with Shahjalal et al.'s finding [11] that the average direct medical costs for cancer were USD 477 per patient, with hospitalization (33%) and surgery (29%) the main components. Gallbladder, brain, and esophageal cancers had the highest costs. Also, they found that costs rose 39% from stage III to IV, with private facilities costing 5% more than public hospitals.

Direct non-medical costs

Direct non-medical costs include round-trip transportation expenses, which for most were less than USD 30.73 (68.81%), with an average of USD 20.50 per visit, a minimum of USD 0, and a maximum of USD 61.46. These low costs may be due to the current patient referral system, which has increasingly decentralized cancer treatment centers to provincial hospitals, allowing patients to access treatment closer to home. This aligns with Héquet et al.'s study [12], which found that 40% of breast cancer patients had additional personal expenditures beyond medical costs, averaging EUR 614 per patient per year. This also aligns with Xia et al.'s study [13], which found that the average direct non-medical costs were USD 2,951 per advanced NSCLC patient, and costs were higher in poor health groups (USD 4,060 vs. USD 2,505). In that study, nutrition was the main cost, with residence, caregiver factors, and hospitalization patterns as key determinants. This aligns with Weraphong et al.'s study [14], which found that direct non-medical costs primarily involved transportation and food expenses. These costs were associated with potentially catastrophic health expenditure, with poor households experiencing higher rates of 30.4% from non-medical costs compared to the lower rates in non-poor groups. This aligns with Liao et al.'s study [15], which found that women with breast cancer had average direct non-medical costs of USD 922. They also found that costs increased significantly with the disease stage, with stages III and IV having higher costs than stages I and II, and stage IV showing the highest expenditure.

Indirect patient costs

The study of the indirect costs among breast cancer patients in Health Region 9 revealed significant findings regarding income loss and employment. Regarding income loss, most patients reported losing less than USD 15.37 per visit because they could manage their time using sick leave or holidays, and their employers and colleagues had a good understanding and allowed them some flexibility. This corresponded with the findings of Huang et al. [16], who analyzed the indirect costs of cancer treatment in Taiwan over a 10-year period (2007–2017) and found that these indirect costs amounted to approximately 200–250 billion Taiwan dollars in total, accounting for 65%–70% of the total economic burden caused by cancer. This reflected that the economic impact of cancer is not limited to medical treatment expenses alone. This was consistent with the research by Franklin et al. [17], who found that breast cancer patients were

able to effectively manage the economic impact of work stoppage, which aligned with research indicating that flexible work policies and workplace support are key factors in reducing indirect costs, especially for breast cancer patients diagnosed at an early stage who can receive outpatient treatment. This was also in line with research by Iragorri et al. [18], who discovered that independent contractors lost up to 43% of their earnings, while employees only lost 24%. Also, compared to male patients (USD 3200), female patients suffered a higher average income loss (USD 8200). Furthermore, they found that caregivers incurred between USD 15,786 and 20,414 expenses per patient annually, and household productivity losses could reach up to as much as USD 238,904. Furthermore, at a societal level, the premature mortality costs amounted to USD 2.98 billion in Quebec, Canada, while overall productivity losses ranged between USD 75 to 317 million per year. These data demonstrate that the indirect costs of cancer are substantial and have wide-ranging impacts, from the individual level to the level of the overall national economy. This was consistent with the findings of Ferrier et al. [19], who reported that 93% of breast cancer patients took at least one period of sick leave, and an average of 2 periods totaling 186 days. Additionally, 24% of patients returned to work part-time after their sick leave, averaging 114 days (equivalent to 41 lost working days). The estimated indirect costs were calculated as USD 25,825 per patient using the human capital approach and USD 8,776 per patient using the friction cost approach.

Caregivers

Caregivers experienced a financial burden in two aspects; 1) lost income from missed work due to accompanying the patient to the treatment center, at an average loss of USD 17.91 USD per visit, and 2) lost income due to the time taken off work to care for patients at home, at an average of USD 4.34 per day. This income loss may be because most caregivers worked in jobs based on a daily income, such as general labor, farming, or service sector jobs. This aligns with the findings of Guerra-Martín et al. [20], who found that caregivers often encounter financial difficulties due to missing work, especially those in daily wage positions or occupations without sick leave benefits. Financial burden is a key factor affecting caregivers' quality of life, and their income level determines the severity of the economic impact that caregivers face. This aligns with the findings of Lim et al. [21], who revealed that many caregivers have to modify their work arrangements or take temporary leave to care for patients, resulting in significant income reduction, especially in countries without welfare systems supporting caregivers. That study also found differences in impact between Singapore and other countries due to variations in the sick leave policies, social welfare systems, and family structures in different countries. The key factors affecting caregivers' work absences included disease severity, treatment duration, the caregivers' occupation types, and their workplace flexibility. This present study reflects Thailand's healthcare system, which can effectively reduce expenses for breast cancer patients through the accessibility to decentralized treatment centers, efficient appointment systems, and comprehensive health insurance coverage. However, there remains an impact on the income of both patients and caregivers, who must take time off work for patient treatment.

In conclusion, this study demonstrates that the economic impact of breast cancer treatment in Thailand in a regional health setting primarily arises from productivity losses from missing work, which represents an indirect cost rather than direct medical expense. Our findings suggest that the provision of services outside of working hours and subsequent follow-up via telemedicine, as well as promoting access to convenient services that are delivered not far from the home, may be viable alternatives for patients obtaining services at a reduced cost and reducing the economic burden on patients and their caregivers.

Research Ethics

The researcher prioritized and protected the rights of individuals participating in this research study based on three principles: 1) Respect for Persons, 2) Beneficence and Non-maleficence, and 3) Justice. These principles take into account respect for human dignity, providing informed consent with sufficient information and freedom in decision-making, respect for privacy, and confidentiality. Before conducting the research, the researcher received approval from the Human Research Ethics Committee of Khon Kaen University on September 5, 2024, approval number HE672107.

Author Contribution Statement

Conceptualization: PI, SP. Formal analysis: PI, PS. Investigation: PI, CP. Methodology, SP, PS, OI. Manuscript writing and revision: All Authors.

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Conflict of Interest

The authors declare that they have no conflicts of interest.

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