RESEARCH ARTICLE

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Survival after Diagnosis of Cervical Cancer Patients at a Tertiary Referral Hospital in Northeast Thailand

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Abstract

Background: Cervical cancer (CC) is the third most common cancer in women globally, including Thailand, where the incidence rate was 16.2 cases per 100,000 individuals in 2018. Survival rates for patients with this condition have not improved over recent years. This study evaluated the survival rate and median survival time after diagnosis among CC patients, and investigated factors associated with survival in Northeast Thailand. **Methods:** This study included CC patients admitted to the gynecological ward at Srinagarind Hospital, Faculty of Medicine, Khon Kaen University, Thailand from 2010 to 2019. Survival rates and median survival time since the date of diagnosis and 95% confidence intervals (CIs) were calculated. Multiple cox regression was performed to investigate factors associated with survival which were quantified by adjusted hazard ratios (AHR) and their 95% CIs. **Results:** Of 2,027 CC patients, the overall mortality incidence rate was 12.44 per 100 person-years (95% CI: 11.7 - 13.22), median survival time was 4.82 years (95% CI: 3.92 - 5.72), and 10-year survival rate was 43.16% (95% CI: 40.71 - 45.59). The highest 10-year survival rate was 87.85% (95% CI: 82.23 - 91.78) found among those with stage I CC, followed by those who received surgical treatment, which was 81.22% (95% CI: 74.47 - 86.35). Factors that were associated with decreased survival included age ≥60 years (AHR = 1.25; 95% CI: 1.07 - 1.46), health insurance with the Universal Health Coverage Scheme (UCS) (AHR = 6.26; 95% CI: 5.13 - 7.64), malignant neoplasms histopathology (AHR = 1.36; 95% CI: 1.07 - 1.74), and treatment with supportive care (AHR = 7.48; 95% CI: 5.22 - 10.71). **Conclusion:** Among patients diagnosed with CC, those with stage I had the highest 10-year survival rate. CC patients with older age, UCS, malignant neoplasms histopathology, and received supportive care showed the highest survival association.

Keywords: Cervical cancer- survival- referral hospital- Northeast- Thailand

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Introduction

Cervical cancer (CC) was the fourth most common cancer in women worldwide, following breast, colorectal, and lung cancers based on GLOBOCAN 2018 estimates (Farahat et al., 2021; Shivamurthy et al., 2022). There were an estimated 311,365 global deaths from CC and 569,847 new cases, or incidence of 15.1 per 100,000 women, in 2018 (Anfinan and Sait, 2020). CC was the third most common type of cancer in Asian women, with 315,346 new cases and 168,411 fatalities (Aoki et al., 2020). In 2020, GLOBOCAN estimated that 604,000 women were diagnosed with CC and 342,000 women died from the disease (Wilailak et al., 2021; Bidhuri et al., 2022). Of these fatalities, 85% occurred in women in low- and middle-income countries (Kengsakul et al., 2021). The mean age of CC patients worldwide was 53 years, and people aged 45 - 55 have the highest incidence (Katanyoo et al., 2021). The most common histological kind of CC was squamous cell carcinoma (SCC) (Anfinan and Sait, 2020), and these are strongly linked to high-risk human papillomavirus (HPV) with genotypes 16 and 18 (Likitdee et al., 2020; Songsiriphan et al., 2020). Smoking, exposure to sex at a young age, having several partners, some sexually transmitted diseases, continuous oral contraceptive use, all increase the chance of having CC (Gupta et al., 2018). Rates are drastically different across regions, probably due to various genetic and environmental variables (Tangjitgamol et al., 2015).

Thailand is a developing country in Southeast Asia classified as upper-middle-income by the World Bank in 2018 (Manchana et al., 2020). Thailand has 15 Population-

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Based Cancer Registries (PBCR) (Kengsakul et al., 2021), one of them is located in Khon Kaen province. In 2018, the Khon Kaen cancer registry identified 8,622 new cases of CC, the incidence rate was 16.2 patients per 100,000 people (Songsiriphan et al., 2020). The primary prevention method for CC is the HPV vaccination. However, major obstacles to a vaccination program remain as the costs are still too high and there is a fear of side effects (Mukem et al., 2016). Many studies have assessed barriers to secondary prevention (screening programs, health promotion, and early precancerous treatment) as embarrassment, poor knowledge, having no symptoms, and busyness or lack of time. Thailand's health policymakers have promoted CC screening through educational and preventive care initiatives covered by health insurance. Thailand has three primary health insurance schemes: the Civil Servant Medical Benefit Scheme (CSMBS, 9%), which provides coverage for government employees, pensioners, and their families (e.g., parents, spouses, and children), beneficiaries are given free admission and ambulatory services and revenue is provided through general taxes. Second, the Social Security Scheme (SSS, 16%) for private sector employees, beneficiaries receive free access to admission and ambulatory services only at registered hospitals that are paid by capitation and revenue imposed on both employers and workers. Third, the Universal Coverage Scheme (UCS, 75%), also known as the gold card or 30-baht scheme is the primary health insurance program in the country, and is mostly funded through revenue from government tax (Paek et al., 2016; Tangtipongkul, 2018; Thokanit et al., 2020).

To date not many studies have focused on the factors that affect CC survival in the Northeast of Thailand (Chua et al., 2021). In addition, the prognostic factors, median survival time, and survival rate for CC patients have not been updated recently for the tertiary referral hospital in Northeast Thailand. Therefore, we studied all newly identified CC cases at Srinagarind Hospital. Our study aimed to evaluate the survival rate and median survival time after diagnosis among CC patients, and to investigate the association between demographic, clinical, and treatment factors and survival at the tertiary referral hospital in Northeast of Thailand.

Materials and Methods

Patient recruitment and study design

We performed a retrospective chart review at the gynecological ward of Srinagarind Hospital, a part of the Faculty of Medicine at Khon Kaen University. Srinagarind Hospital is the largest public hospital in northeastern Thailand, with a capacity of 1,500 beds and an annual patient count of over one million (Saenrueang et al., 2019). The study included 2,027 CC cases, whose diagnosis dates were reported in chart review between 2010 and 2019. Patients who were not Thai nationals were excluded from the study.

Primary outcome and study factors

The primary outcome for this study was the elapsed time in years from diagnosis with CC (begin date) to death or last follow-up (end-date), with a maximum follow-up period of 10 years. The values of this outcome were number of years from the date of diagnosis until death. Factors analyzed were grouped into three categories: 1) Demographic information, such as age at the diagnosis, marital status, occupation, and health insurance. 2) Clinical diagnosis, including basis of diagnosis, staging (stage I-IV), and histopathology which categorized as squamous cell carcinoma, adenocarcinoma, malignant neoplasms (include unspecified neoplasms), and others (sarcoma, carcinosarcoma, and melanoma). 3) Treatment modalities, including surgery, radiation, chemotherapy, concurrent chemoradiotherapy (CCRT), surgery + radiotherapy, surgery + chemotherapy, surgery + radiotherapy + chemotherapy, as well as supportive care.

Statistical analysis

The baseline characteristics of CC patients were described using frequency and percentage for categorical data. The mean, standard deviation (SD), median, and minimum and maximum ranges were used for continuous data. Incidence rate of CC death per 100 person-years since diagnosis and its 95% confidence interval (CI) were calculated using Poisson distribution assumption.

Kaplan-Meier techniques were used to assess the survival rate and median survival time from CC diagnosis until death by CC. Simple cox regression analysis was used to evaluate the association between each factor and CC survival one at a time, with results presented as crude hazard ratios (HR). Multiple cox regression analysis was then performed to evaluate the association between each factor and CC survival, adjusting for all factors. Results were presented as adjusted HR (AHR) and their 95% Cis, as well as the p-value. All test were two-sided, with a statistically significant p-value of less than 0.05. Analyses were conducted using STATA version 15 (StataCorp, College Station, TX).

Results

Characteristics of CC patients

A total of 2,027 CC patients were included in the analysis, with a mean age of diagnosis of 53.44 years (SD = 12.2) and ranged from 22 to 91 years. Around one-third (30.74%) of patients were aged ≥60. Almost all patients were married (92.5%). The majority of patients were employed in the agricultural sector (44.95%). According to the health insurance, 65.22% were covered by UCS, 30.04% by CSMBS and 4.74% by SSS. Most patients were diagnosed at stages III and IV (42.23% and 27.08%, respectively), and had SCC (67.34%) histopathology. The most common primary treatment received was concurrent chemoradiotherapy (27.73%) (Table 1).

Survival Analysis

Table 2 shows the incidence rate and median survival time for CC patients from diagnosis to death. Of 2,027 CC patients observed for 8,322 person-years after diagnosis, 1,035 had died by the end of the observation period. The overall mortality incidence rate was 12.44 per 100 patients

Table 1. Characteristics of CC Patients

Characteristics	Number	Percentage
Age at diagnosis		
<30	29	1.43
30-49	778	38.38
50-59	597	29.45
≥60	623	30.74
Mean (standard deviation)	53.44 (12.20)	
Range	22 - 91	
Marital status		
Married	1,875	92.5
Single	152	7.5
Occupation *		
Agriculturist	458	44.95
Housewife	174	17.08
Freelance	146	14.33
Merchant	104	10.21
Government officer	80	7.84
Others	57	5.59
Health insurance		
Universal health coverage scheme	1,322	65.22
Civil servant medical benefit scheme	609	30.04
Social security scheme	96	4.74

Table 1. Continued

Characteristics	Number	Percentage
Stage		
Stage I	253	12.48
Stage II	369	18.21
Stage III	856	42.23
Stage IV	549	27.08
Histopathology		
Squamous cell carcinoma	1,365	67.34
Adenocarcinoma	386	19.05
Malignant neoplasms	145	7.15
Others **	131	6.46
Treatment		
Surgery	215	10.61
Radiotherapy	501	24.72
Chemotherapy	50	2.47
Supportive care	473	23.33
Concurrent chemoradiotherapy	562	27.73
Surgery + radiotherapy	90	4.44
Surgery + chemotherapy	22	1.08
Surgery + radiotherapy + chemotherapy	114	5.62

*, For occupation approximately 50% of participants did not provide any information so the total for this variable is smaller; **, Sarcoma, Carcinosarcoma, and Melanoma

per year (95% CI: 11.70 - 13.22). The overall median survival time was 4.82 years (95% CI: 4.05 - 5.72) as shown by the Kaplan-Meier curve in Figure 1A. The longest median survival time was for those aged 50-59 years (6.85 years, 95% CI: 4.58 - 11.11) as shown in Figure 1B. Figure 1C and 1D show that among health insurance groups CSMBS and SSS, and treatment groups surgery, surgery + radiotherapy, surgery + chemotherapy,

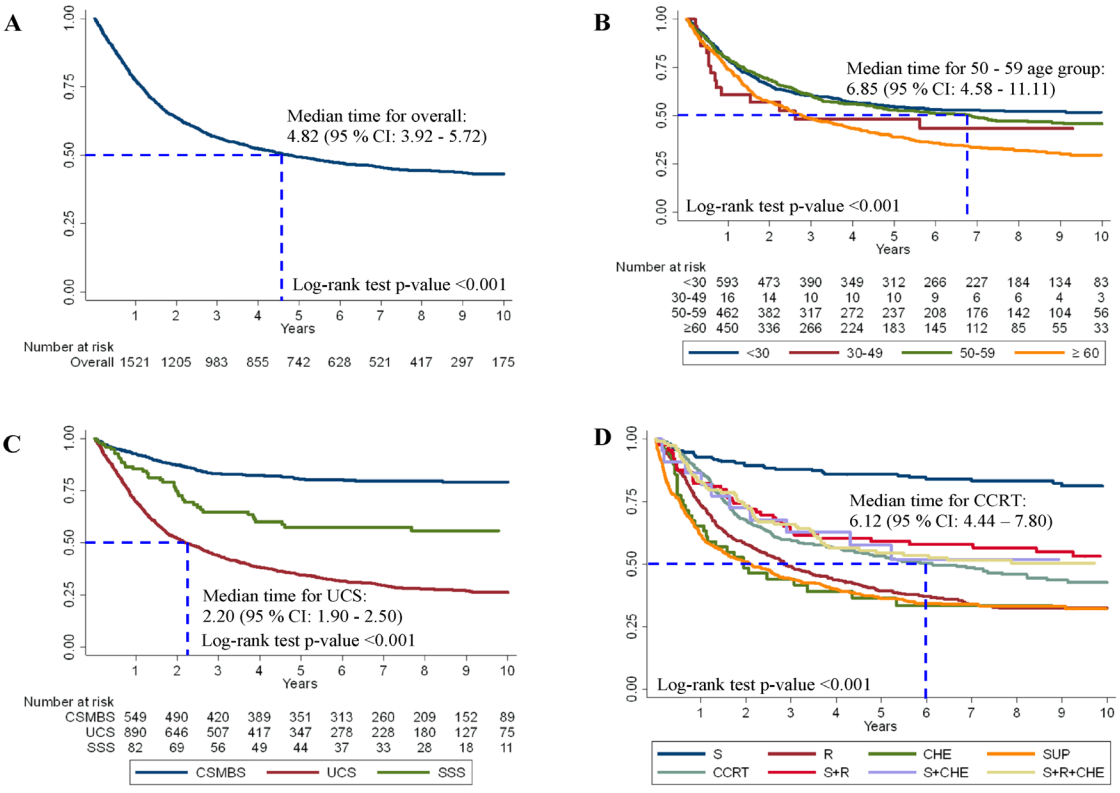

Figure 1. The Kaplan-Meier Curve of CC Patients. (A), Overall; (B), Separated by age groups; (C), Separated by health insurance; (D), Separated by treatments.

Table 2. Incidence Rate of Death Per 100 Person-Years and Median Time of CC Patients

Factors	Number (Person-year)	IR/100 (95% CI)	Median time (95% CI)
Overall	8,322	12.44 (11.70 - 13.22)	4.82 (3.92 - 5.72)
Age at diagnosis			
<30	104	14.42 (8.69 - 23.91)	2.61 (0.68 - 10.82)
30-49	3,394	10.08 (9.06 - 11.20)	-
50-59	2,635	10.93 (9.74 - 12.27)	6.85 (4.58 - 11.11)
≥60	2,189	17.82 (16.13 - 19.68)	2.79 (2.20 - 3.38)
Marital status			
Married	7,650	12.48 (11.72 - 13.30)	4.75 (3.82 - 5.68)
Single	671	11.92 (9.57 - 14.84)	5.45 (1.56 - 9.34)
Health insurance			
Universal health coverage scheme	4,331	20.34 (19.04 - 21.73)	2.2 (1.90 - 2.50)
Social security scheme	478	8.38 (6.14 - 11.42)	-
Civil servant medical benefit scheme	3,513	3.24 (2.70 - 3.90)	-
Stage			
Stage I	1,798	1.39 (0.94 - 2.06)	-
Stage II	1,855	9.22 (7.93 - 10.71)	-
Stage III	3,214	14.44 (13.18 - 15.81)	4.05 (3.21 - 4.89)
Stage IV	1,454	25.80 (23.31 - 28.54)	1.45 (1.13 - 1.77)
Histopathology			
Malignant neoplasms	453	17.44 (13.99 - 21.74)	3.13 (1.58 - 5.49)
Adenocarcinoma	1,570	13.06 (11.39 - 14.97)	4.42 (2.59 - 6.25)
Squamous cell carcinoma	5,799	11.73 (10.88 - 12.64)	5.19 (3.82 - 6.56)
Others	499	14.22 (11.27 - 17.95)	3.72 (1.98 - 5.46)
Treatment			
Chemotherapy	148	20.92 (14.72 - 29.75)	1.95 (0.71 - 3.19)
Supportive care	1,471	19.98 (17.83 - 22.40)	2.11 (1.55 - 2.67)
Radiotherapy	1,879	16.66 (14.91 - 18.61)	2.85 (2.19 - 3.51)
Concurrent chemoradiotherapy	2,103	12.27 (10.86 - 13.86)	6.12 (4.44 - 7.80)
Surgery + chemotherapy	108	9.23 (4.97 - 17.16)	-
Surgery + radiotherapy + chemotherapy	644	8.39 (6.42 - 10.95)	-
Surgery + radiotherapy	517	7.74 (5.68 - 10.55)	-
Surgery	1,451	2.41 (1.73 - 3.36)	-

and surgery + radiotherapy + chemotherapy, the median survival time after diagnosis in not shown because survival was greater than 50% at the last time point.

The 1-year, 5-year, and 10-year survival rates were 77.36% (95% CI: 75.46 - 79.14), 49.29% (95% CI: 46.98 - 51.55), and 43.16% (95% CI: 40.71 - 45.59) respectively (Figure 2A and Table 3). Patients covered under the CSMBS had the highest survival rates, with 92.81% (95% CI: 90.43 - 94.62) at 1-year, 80.58% (95% CI: 77.03 - 83.65) at 5-year, and 79.14% (95% CI: 75.38 - 82.39) at 10-year (Figure 2B). The log-rank test (p-value <0.001) also shows statistically significant differences in the survival times of different groups.

Association between factors and survival of CC patients Bivariate and multivariable analysis

Table 4 shows factors associated with CC survival. The multivariable analysis using multiple cox regression in our study found that patients aged ≥60 years had greater chance of dying (AHR = 1.25; 95% CI: 1.07 - 1.46) compared to those aged 30-49 (p-value = 0.004). The risk was also higher for those covered under UCS (AHR = 6.26; 95% CI: 5.13 - 7.64), and SSS (AHR = 3.84; 95% CI: 2.66 - 5.54) compared to those covered by CSMBS in the health insurance scheme (p-value <0.001), and for those with malignant neoplasms in histopathology (AHR = 1.36; 95% CI: 1.07 - 1.74) compared to the SCC group (p-value = 0.009). Receiving supportive care also had a higher risk (AHR = 7.48; 95% CI: 5.22 - 10.71) compared to the surgery treatment group (p-value <0.001).

Discussion

Our study evaluated the survival rate and median survival time of 2,027 CC patients after diagnosis, and determined the association between important prognostic factors and survival. The study found that the overall median survival time of CC patients was 4.82 years, which

Table 3. The Survival rate of CC Patients

Factors	Survival rate (95% CI)		
	1-year	5-year	10-year
Overall	77.36 (75.46 - 79.14)	49.29 (46.98 - 51.55)	43.16 (40.71 - 45.59)
Age at diagnosis			
<30	60.84 (40.40 - 76.15)	48.26 (28.39 - 65.61)	43.44 (23.96 - 61.47)
30-49	78.97 (75.90 - 81.70)	54.71 (50.95 - 58.30)	51.87 (47.97 - 55.61)
50-59	79.58 (76.09 - 82.62)	53.11 (48.83 - 57.20)	46.00 (41.44 - 50.43)
≥60	73.98 (70.32 - 77.27)	39.21 (35.18 - 43.21)	29.73 (25.44 - 34.12)
Health insurance			
Civil servant medical benefit scheme	92.81 (90.43 - 94.62)	80.58 (77.03 - 83.65)	79.14 (75.38 - 82.39)
Social security scheme	85.42 (76.62 - 91.09)	57.48 (46.59 - 66.93)	55.74 (44.65 - 65.46)
Universal health coverage scheme	69.64 (67.06 - 72.07)	34.55 (31.86 - 37.25)	26.24 (23.52 - 29.03)
Stage			
Stage I	97.57 (94.67 - 98.90)	91.84 (87.49 - 94.72)	87.85 (82.23 - 91.78)
Stage II	83.89 (79.71 - 87.28)	55.37 (49.96 - 60.44)	50.00 (44.42 - 55.32)
Stage III	81.26 (78.44 - 83.74)	46.07 (42.47 - 49.59)	36.69 (32.74 - 40.64)
Stage IV	57.49 (53.19 - 61.55)	29.92 (25.91 - 34.02)	25.41 (21.01 - 30.04)
Histopathology			
Squamous cell carcinoma	79.39 (77.12 - 81.46)	50.39 (47.57 - 53.14)	44.46 (41.49 - 47.38)
Adenocarcinoma	74.94 (70.28 - 78.98)	48.50 (43.23 - 53.56)	41.07 (35.32 - 46.72)
Malignant neoplasms	66.02 (57.66 - 73.11)	46.17 (37.36 - 54.51)	39.39 (30.18 - 48.46)
Others	76.11 (67.79 - 82.55)	44.26 (35.09 - 53.04)	40.64 (31.43 - 49.65)
Treatment			
Surgery	92.89 (88.49 - 95.65)	85.84 (80.25 - 89.94)	81.22 (74.47 - 86.35)
Concurrent chemoradiotherapy	86.63 (83.48 - 89.22)	53.33 (48.76 - 57.68)	42.72 (37.07 - 48.24)
Surgery + chemotherapy	86.36 (63.44 - 95.39)	57.55 (34.07 - 75.31)	51.80 (28.64 - 70.75)
Surgery + radiotherapy + chemotherapy	83.09 (74.78 - 88.86)	54.51 (44.69 - 63.30)	50.39 (40.57 - 59.14)
Surgery + radiotherapy	82.22 (72.63 - 88.71)	59.16 (48.12 - 68.61)	53.14 (41.76 - 63.27)
Radiotherapy	73.73 (69.62 - 77.38)	39.23 (34.77 - 43.66)	32.44 (28.00 - 36.94)
Chemotherapy	65.27 (50.19 - 76.79)	36.32 (22.64 - 50.13)	-
Supportive care	61.63 (57.04 - 65.89)	36.13 (31.56 - 40.71)	32.14 (27.30 - 37.06)

Others, Sarcoma, Carcinosarcoma, and Melanoma; CI, Confidence interval

was lower than a study in France (6.5 years) (Melan et al., 2017), and the US where CC patients in metro areas (126.9 months) (Lababidi et al., 2022). The 5-year survival rate in our study was 49.29%, which is lower than a study in

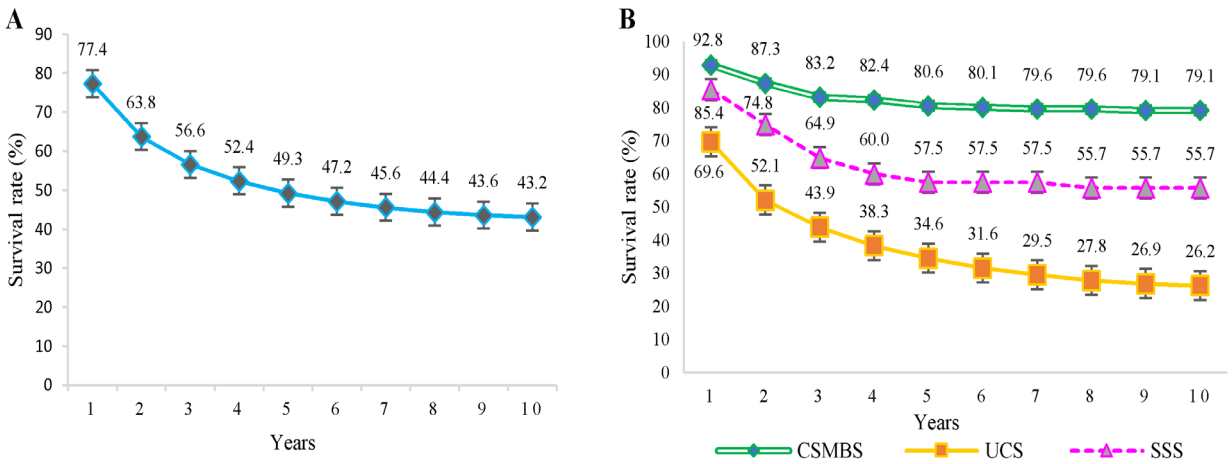

Figure 2. The 10-year survival rate of CC patients. (A) Overall survival rate. (B) Survival rate separated by health insurance.

Table 4. Bivariate and Multivariable Analysis of Influencing Factors Associated with Survival of CC Patients

Factors	Crude HR (95% CI)	p-value	Adjusted HR (95% CI)	p-value
Age at diagnosis		<0.001		0.004
<30	1.42 (0.85 - 2.39)		1.53 (0.91 - 2.58)	
30-49	1		1	
50-59	1.08 (0.92 - 1.26)		0.98 (0.83 - 1.14)	
≥60	1.57 (1.37 - 1.83)		1.25 (1.07 - 1.46)	
Health insurance		<0.001		<0.001
Civil servant medical benefit scheme	1		1	
Social security scheme	2.44 (1.70 - 3.50)		3.84 (2.66 - 5.54)	
Universal health coverage scheme	5.22 (4.29 - 6.35)		6.26 (5.13 - 7.64)	
Histopathology		0.077		0.009
Squamous cell carcinoma	1		1	
Adenocarcinoma	1.09 (0.93 - 1.28)		1.16 (0.99 - 1.36)	
Malignant neoplasms	1.34 (1.06 - 1.69)		1.36 (1.07 - 1.74)	
Others	1.16 (0.91 - 1.48)		1.31 (1.03 - 1.68)	
Treatment		<0.001		<0.001
Surgery	1		1	
Concurrent chemoradiotherapy	3.76 (2.64 - 5.36)		3.41 (2.39 - 4.86)	
Radiotherapy	5.48 (3.86 - 7.78)		5.46 (3.81 - 7.81)	
Supportive care	6.43 (4.53 - 9.13)		7.48 (5.22 - 10.71)	
Chemotherapy	6.28 (3.87 - 10.20)		6.39 (3.92 - 10.41)	
Surgery + radiotherapy	3.14 (1.99 - 4.94)		3.54 (2.24 - 5.59)	
Surgery + chemotherapy	3.35 (1.66 - 6.77)		3.24 (1.60 - 6.59)	
Surgery + radiotherapy + chemotherapy	3.37 (2.20 - 5.16)		2.97 (1.94 - 4.56)	

Others, Sarcoma, Carcinosarcoma, and Melanoma; HR, Hazard ratios; CI: Confidence interval

a tertiary care center in Eastern Europe (69.9%) (Stanca and Căpîlna, 2021), and Korea (80.8%) (Ha et al., 2021). This may be due to the fact that our study was conducted at Srinagarind Hospital, which is a tertiary referral hospital that receives numerous referrals for patients with advanced CC, leading to a large number of patients with advanced stage CC in our research.

Our findings revealed that the 5-year survival rate was highest among patients aged 30-40 years at diagnosis (54.71%), and lowest among those aged ≥60 (39.21%). These results are consistent with previous studies in Korea (Rangel et al., 2021), and Japan (Mikami et al., 2018). Our results suggest that younger patients had a higher 5-year survival rate compared to older patients, and that the survival rate decreased as age increased.

Our study is one of the few to report on CC survival by health insurance coverage group in Thailand. The results indicate that those participants covered by the CSMBS health insurance scheme had the highest 5-year survival rate (80.58%), followed by SSS (57.48%), and UCS (34.55%). These findings are consistent with previous research at Mahidol University, Thailand (Thokanit et al., 2020). The Ministry of Public Health and National Health Security Office in Thailand offers nationwide CC screening campaigns every 5 years for all Thai women aged 30-60 under UCS, free of charge. However, obstacles such as lack of education, misunderstandings about screenings, and lower income can impede access to these services. Additionally, cultural and religious beliefs, such as a strong emphasis on modesty and virginity before marriage, may discourage young and unmarried females from seeking care (Kengsakul et al., 2021; Sripan et al., 2022). This highlights the need to consider the country's demographic and cultural diversity when developing and implementing screening programs.

Additionally, our study found that the 5-year survival rate was highest among patients diagnosed with stage I, which is consistent with studies conducted at Ramathibodi Hospital in Bangkok, Thailand (81.8%), (Thokanit et al., 2020), and Japan (92.1%) (Nagase et al., 2019). These results indicate that patients diagnosed with advanced stages have a poorer chance of survival than those diagnosed at an early stage (Ganesarajah et al., 2022). Additionally, our study found that the 5-year survival rate for patients with SCC histopathology was higher than other groups, which is consistent with findings from other studies in Korea (Ha et al., 2021), Japan (Nagase et al., 2019), and Chiang Mai University Hospital in Thailand. SCC may have a lower mortality rate because it develops from cells in the ectocervix, whereas adenocarcinoma (ADC) develops from glandular cells in the endocervix. Screening programs, such as Pap smears, are more likely to detect abnormal cells of SCC or precancerous lesions, but ADC may not show clinical symptoms until advanced stages (Intaraphet et al., 2013). Furthermore, our study found that CC patients who underwent surgery alone

had better survival outcomes than those receiving other treatments, as seen in China (Liang et al., 2021) and Japan (Mikami et al., 2018). This is likely because surgery is the primary treatment and one of the most effective treatments for CC (Fader, 2018).

In our multivariable model, we excluded the stage of CC factor because it was strongly correlated with the type of treatment factor. Our results showed that CC patients in older age group had a significantly higher risk of death compared to younger patients. This finding is consistent with a study of Asian-American women (Nghiem et al., 2016), and in Japan (Mikami et al., 2018). This outcome may be due to the fact that older individuals are a particularly high-risk group because they may be unable to tolerate therapies or may not benefit from them as much due to their pre-existing frailty (Quinn et al., 2019). Our study found that there have been few studies on the insurance status of CC patients. We discovered that patients with UCS and SSS health insurance had a higher risk of death compared to those in the CSMBS group. Our findings align with a study from Ramathibodi Hospital in Thailand, which found that the CSMBS and SSS groups had HRs of 0.71 (95% CI: 0.49 - 1.02) and 1.17 (95% CI: 0.75 - 1.83) respectively, compared to UCS, but these results were not statistically significant (Thokanit et al., 2020). The UCS group had the highest mortality risk, possibly due to it being the primary health insurance option and covering the largest proportion of the population for CC screening. Despite intensive prevention efforts, many women still lack access to regular screening services, particularly in the UCS group. This may be due to their occupation as agriculturists, housewives, or self-employed individuals, as well as the demanding nature of their work.

Interestingly, our results show that CC patients with malignant neoplasms have a higher risk of death compared to the SCC group. This differs from a previous study at Chiang Mai University Hospital in Thailand, which found the highest risk of death to be in the small cell neuroendocrine group (AHR = 2.60; 95% CI: 1.90 - 3.50) followed by ADC (AHR = 1.3; 95% CI: 1.1 - 1.5) (Intaraphet et al., 2013). Another study in Japan found the ADC group to have the highest risk (AHR = 1.93; 95% CI: 1.78 - 2.09) (Mikami et al., 2018). In contrast to SCC, ADC is more likely to cause distant recurrence through hematogenous dissemination (Rangel et al., 2021). Our results also show that CC patients who received supportive care have a higher chance of dying compared to those who underwent surgical treatment alone, similar to a study in Bhutan (AHR = 30.10, 95% CI: 12 - 75.6) (Tshewang et al., 2021). This may be due to the stage of the disease; patients with early-stage disease would only have undergone surgery, while palliative or chemoradiation therapy is frequently used for CC patients with distant metastatic disease.

Our study had several strengths, including a large patient sample size of CC over a 10-year period, minimal missing data, and a significant number of cases referred to Srinagarind Hospital in Khon Kaen, Thailand - the largest database for a public hospital in the North-East region. Additionally, our study was conducted at a single institution, which may have reduced variability in initial and subsequent treatments.

Limitations of our study are that the sample may not be representative of the entire Thai population as it was conducted in the northeastern region only, and from only one hospital. We also did not have information available on time from diagnosis to treatment, and treatment after recurrence, which may have been valuable in understanding survival outcomes. However, our study still provided important information and insights that can inform future research on CC. Therefore, further studies in other regions of Thailand are needed to confirm these findings.

In conclusion, our study found that the probability of overall survival among CC patients was highest for those in stage I, with a high 10-year survival rate. Factors such as older age, coverage by UCS and SSS health insurance schemes, certain histopathology types of malignant neoplasms, and certain treatment options were found to significantly increase the risk of mortality after diagnosis. These findings are important for public health officials, policymakers, and government officials to consider as they work to improve access to early detection services and effective treatments to prolong the survival of women diagnosed with CC.

Author Contribution Statement

RW, NL, and KT initiated the idea, and provided constructive criticism and edited of the drafts of the manuscripts. RW and KT performed data management and data quality assurance, data analysis, and wrote all statistical methods and the results sections of the manuscript. RW, NL, KT, and MK initiated the idea, provided feedback and edited the drafts of the manuscript. All authors have seen and approved the final version of the manuscript.

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Approval

This paper is a part of the dissertation submitted in fulfillment of the requirement for the degree of Doctor of Public Health Program, Faculty of Public Health, Khon Kaen University, Thailand.

Ethical considerations

This study was approved by the Khon Kaen University Ethics Committee for Human Research under the reference number HE651138. All subjects gave written, informed consent to participate in the study and for their anonymized data to be used for statistical analysis and dissemination.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interest

The authors declare that they have no competing interests.

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