RESEARCH ARTICLE

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Health Literacy and COVID-19 Vaccination among Cancer Patients in Northeastern Thailand: A Cross-Sectional Study

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Abstract

Objective: This study aimed to explore factors associated with COVID-19 vaccine uptake among patients with cancer in northeastern Thailand. **Methods:** A cross-sectional study was conducted in northeastern Thailand between December 29th, 2022 and January 31st, 2023. A community-based, multistage sampling method was used to select patients with any medically diagnosed cancer. An interview form was developed to assess patient sociodemographic factors, health literacy, and COVID-19 vaccination status. Multivariable logistic regression analysis was used to identify the factors associated with COVID-19 vaccination status. **Results:** Of the 449 participants, 368 (81.96%) had received at least two doses of a COVID-19 vaccine. The multivariable analysis revealed that factors associated with COVID-19 vaccination among cancer patients included: 1) health literacy (excellent: adjusted odd ratio (OR_{Adj}) = 7.23; 95% confidence interval (CI): 2.11–24.71, p = 0.002); sufficient: OR_{Adj} = 6.03; 95% CI: 2.00–18.24, p = 0.001); problematic: OR_{Adj} = 3.88; 95% CI:1.37–11.00, p = 0.011); 2) marital status (OR_{Adj} = 2.90; 95% CI: 1.37–6.14, p = 0.005); 3) cancer treatment at a general hospital (OR_{Adj} = 2.50; 95% CI: 1.25–5.00, p = 0.010); and 4) history of laboratory-confirmed COVID-19 infection (OR_{Adj} = 2.37; 95% CI:1.19–4.71, p = 0.014). **Conclusions:** The strongest predictor of receiving COVID-19 vaccines was health literacy, which enhances healthcare provider awareness of communicable disease prevention and control for patients with cancer as well as counselling and educating to improve their health literacy. It could influent a higher rate of vaccine uptake among patients with cancer.

Keywords: COVID-19- Patients with cancer- Vaccination- Health literacy

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Introduction

The first case of novel coronavirus disease (COVID-19) was detected in December 2019, with the virus spreading rapidly and declared a Public Health Emergency of International Concern by the World Health Organization (WHO) on January 30th, 2020 (WHO, 2020). The WHO aimed to eliminate the global public health emergency of COVID-19 through two strategies (WHO, 2022). The first strategy was to limit and control the incidence of SARS-CoV-2 infection, which is critical for safeguarding individuals, particularly those who are at risk of serious disease or occupational exposure to the virus. The second strategy was to decrease morbidity, long-term sequelae, and mortality through prevention, timely diagnosis, and effective treatment. Cancer care has been one of the most affected medical fields during the pandemic. Patients may chose or have to delay or discontinue care, leading to delays or a lack of diagnosis and treatment (Yadav et al., 2020). A study of patients with COVID-19 reported that patients with cancer were more likely to have severe symptoms than those without cancer (adjusted odds ratio (OR_{Adj}) = 3.61; 95% confidence interval (CI): 2.59–5.40, p = 0.001) and had longer recovery times than those without (mean = 24 days (interquartile range (IQR) = 17–29 days) vs. mean = 21 days (IQR = 15–24 days), respectively; p = 0.045) (Tian et al., 2020). A meta-analysis reported that all vaccine types effectively prevented severe of the COVID-19 illness in patients with cancer (risk ratio = 0.12; 95% CI: 0.040–0.363, p < 0.001) (Huang and Kuan, 2022).

Coronavirus disease presents a serious health challenge for patients with cancer, and full vaccination (two or more doses) helps reduce the severity of the illness and the risk of death. The Ministry of Public Health of Thailand has estimated that there were nearly 87,000 patients with cancer in the 20 provinces of northeastern Thailand (Ministry of Public Health of Thailand, 2022). A study was conducted on SARS-CoV-2 seroprevalence among patients with cancer and their household caregivers in a cancer hospital in Bangkok, Thailand, between March 4th and May 31st, 2021 (Ungtrakul et al., 2022). The study

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found that only four of 200 cancer patients had received a COVID-19 vaccination between the end of the second COVID-19 wave and the beginning of the third wave in Thailand. There are few studies in Thailand of the effects of health literacy and sociodemographic on the COVID-19 vaccination status of patients with cancer. Therefore, we explored health literacy and other factors associated with COVID-19 vaccine uptake among patients with cancer in northeastern Thailand.

Materials and Methods

This cross-sectional, questionnaire-based study was conducted in northeastern Thailand from December 29th, 2022 to January 31st, 2023. The sample population was selected through multistage random sampling, initially classifying 20 northeastern provinces into four health regions. One province was randomly selected from each health region, and five districts were randomly selected from each of the selected provinces. The number of interviews in each district was proportional to the number of cancer patients in that district. Individual participants were selected through simple random sampling of hospital registers, with a goal of 465 completed interviews.

Participants

The study included 449 patients who met the following inclusion criteria: (1) 18 years of age or older, (2) living in a house registered in the sampled district in northeastern Thailand, (3) being diagnosed with cancer by a doctor, (4) being able to complete the interview form, and (5) agreeing to participate in the study by signing an informed consent form.

Instruments

The questionnaire consisted of three parts: (1) sociodemographic information (sex, age, marital status, level of education, average monthly income, residential area, and number of family members); (2) personal medical history (type of cancer, time since cancer diagnosis, ongoing treatments, comorbid diseases, healthcare facilities for cancer treatment, health insurance, and history of laboratory confirmed COVID-19 infection); and (3) health literacy level, assessed by the 47 item European Health Literacy Questionnaire (HLS-EU-Q47). The HLS-EU-Q47 is based on a conceptual model of health literacy and measures four competencies for dealing with health-related information (Assessing, understanding, evaluation, and application) in three domains: healthcare, disease prevention, and health promotion (Sørensen et al., 2012). Participants responded to their difficulty with each item on a 4-point Likert scale (1 = very difficult, 2 = difficult, 3 = easy, 4 = very easy). The indices were then standardized to unified metrics ranging from 0 to 50 using the formula: Index (mean - 1) *(50/3) (Duong, et al., 2017). The four levels were determined as follows: inadequate (0–25), problematic (26–33), sufficient (34–42), and excellent (43–50) health literacy (Sørensen et al., 2015). Participants were initially asked if they had ever received a COVID-19 vaccine, and if so, how many doses. The questionnaire was constructed and evaluated for validity by a panel of three experts in the fields of health behaviour, epidemiology, and research methodology. The final 71 item questionnaire had an item-objective congruence greater than 0.50. Reliability testing showed a Cronbach's alpha of 0.95.

Statistical Analysis

Sociodemographic characteristics and questionnaire responses were categorised and presented as numbers and percentages, respectively. Univariable logistic regression was utilised to investigate the associations between each independent variable (sociodemographic characteristics and health literacy) and the outcome variable (having received at least two doses of a COVID-19 vaccine). Variables with a p-value < 0.25 in the univariable analysis were included in the multivariable logistic regression analysis, using backward elimination. All data were analysed using STATA version 15 (StataCorp., LLC. College Station, TX). A p-value less than 0.05 was considered statistically significant.

Results

Characteristics of participants and COVID-19 vaccinations

A total of 449 patients participated in the study. Of these, 368 had received at least two doses of vaccine, for a vaccination rate of 81.96%. Participants had a mean age of 60.96 years (S.D. ± 12.12, range 20–97 years), a mean average monthly income of 4,047.68 Thai Bath (S.D. ± 5,788.15, range 600–63,000 Thai Bath), and a mean time since cancer diagnosis of 4.90 years (S.D. ± 4.02, range 1–25 years). The majority of participants were female (75.72%), married (68.37%), had graduated from primary school (69.49%), and lived in rural areas (79.28%). In terms of healthcare, The most common diagnosis was breast cancer (30.07%), had no comorbid diseases (72.16%), were receiving ongoing cancer treatments (94.21%), were receiving treatment at a general hospital (49.67%), and were covered by Thai Universal Health Care (83.52%). Reported COVID-19 infections were laboratory-confirmed for (26.50%) of patients, and 53.55% had inadequate or problematic health literacy (Table 1).

Factors associated with COVID-19 vaccination

Univariable regression analysis revealed seven predictors of vaccination status with p-values < 0.25 (marital status, number of family members, type of cancer, ongoing treatment, healthcare facilities for cancer treatment, history of laboratory confirmation of COVID-19 infection, and level of health literacy), which were included in multivariable models (Table 2). In the final models, only health literacy level, marital status, healthcare facility, and history of laboratory confirmation of COVID-19 infection remained significant predictors of vaccination status (p = 0.001) (Table 3).

Cancer patients with excellent health literacy had a 7.23-times higher probability of being vaccinated compared to those with inadequate health literacy (OR_{Adj} = 7.23; 95% CI:2.11–24.71, p-value = 0.002). Participants with sufficient health literacy had a 6.03-times higher

Table 1. Sociodemographic Characteristics, Medical Histories, and Health Literacy Status of Participants

Factors	Number (n= 449)	Percentage
Sex		
Male	109	24.28
Female	340	75.72
Age (years)		
18–59	189	42.09
≥ 60	260	57.91
Mean (S.D.)	60.96 (12.12)	
Median (Minimum, Maximum)	61 (20, 97)	
Marital status		
Single	48	10.69
Married	307	68.37
Divorced / Widowed	94	20.94
Level of Education		
Illiterate	39	8.69
Primary school	312	69.49
High school	67	14.92
Diploma / University	31	6.90
Average monthly income (Thai Bath)		
≤ 3,000	203	45.21
3,001–9,000	210	46.77
> 9,000	36	8.02
Mean (S.D.)	4,047.68 (5,788.15)	
Median (Minimum, Maximum)	3,000.00 (600, 63,000)	
Residential area		
Rural	356	79.28
Suburban	83	18.49
Urban	10	2.23
Numbers of Family members		
1–2	73	16.26
3–4	176	39.20
≥ 5	200	44.54
Mean (S.D.)	4.08 (1.61)	
Median (Minimum, Maximum)	4.00 (1, 13)	
Type of cancer		
Colorectal cancer	69	15.37
Liver and bile duct cancer	46	10.24
Lung cancer	17	3.79
Breast cancer	135	30.07
Cervical cancer	48	10.69
Other types of cancer	134	29.84
Time since the cancer diagnosis (years)		
≤ 1	79	17.59
2–4	137	30.52
≥ 5	233	51.89
Mean (S.D.)	4.90 (4.02)	
Median (Minimum, Maximum)	5.00 (1, 25)	
Ongoing treatments		
No	26	5.79
Yes	423	94.21
Other health insurance	74	16.48
Healthcare facilities for cancer treatment		
Community hospitals	67	14.92
General hospitals	223	49.67
Regional hospital	91	20.27
University hospital	22	4.90
Other medical facilities	46	10.24
Health insurance		
Universal Health Care	375	83.52
Other health insurance	74	16.48
History of laboratory confirmation of COVID-19 infection		
No	330	73.50
Yes	119	26.50
Comorbid diseases		
No	324	72.16
Yes	125	27.84
Level of health literacy		
Inadequate	19	4.23
Problematic	221	49.22
Sufficient	135	30.07
Excellent	74	16.48
Prior COVID-19 vaccination (at least two doses)		
Unvaccinated	81	18.04
Vaccinated	368	81.96

probability of having been vaccinated (OR_{Adj} = 6.03; 95% CI:2.00–18.24, p-value = 0.001), whereas those with problematic health literacy had a 3.88-times higher probability (OR_{Adj} = 3.88; 95% CI:1.37–11.00, p-value = 0.011). Married participants had a 2.90-times higher probability of prior vaccination than those who were single (OR_{Adj} = 2.90;95% CI:1.37–6.14, p-value = 0.005). Cancer patients who received cancer treatment at general hospitals had a 2.50-times higher probability of receiving the vaccination than those receiving cancer treatment at community hospitals (OR_{Adj} = 2.50;95% CI:1.25–5.00, p-value = 0.010), and those with a history of laboratory confirmation of COVID-19 infection had a 2.37-times higher probability of receiving the vaccination than those with no history of laboratory confirmation of COVID-19 infection (OR_{Adj} = 2.37; 95% CI:1.19–4.71, p-value = 0.014) (Table 3).

Discussion

This study explored rates of COVID-19 vaccination and identified factors associated with COVID-19 vaccination among patients with cancer in northeastern Thailand two years into the pandemic. However, there is a scarcity of reports of vaccination levels specific to cancer patients. This study provides data that may be utilised to assist health authorities in enhancing COVID-19 vaccination strategies among patients with cancer in Thailand.

Compared to other studies conducted among patients with cancer, the vaccination rate of the COVID-19

Table 2. Univariable Analysis: Predictive value of participants' sociodemographic characteristics, medical histories, and health literacy status for their COVID-19 vaccination status

Univariate analysis Factors	All participants (n = 449)	Vaccinated (at least two doses) (%)	Crude OR	95% CI	p-value
Sex					0.704
Male	109	88 (80.73%)	Ref.		
Female	340	280 (82.35%)	1.11	0.64–1.93	0.702
Age (years)					0.440
35–59	189	158 (83.60%)	Ref.		
≥ 60	260	210 (80.77%)	0.82	0.50–1.35	0.442
Marital status					0.023
Single	48	33 (68.75%)	Ref.		
Married	307	261 (85.02%)	2.58	1.30–5.12	0.007
Divorced / Widowed	94	74 (78.72%)	1.68	0.77–3.69	0.194
Level of Education					0.758
Illiterate	39	30 (76.92%)	Ref.		
Primary school	312	255 (81.73%)	1.34	0.60–2.98	0.470
High school	67	57 (85.07%)	1.71	0.63–4.66	0.295
Diploma / University	31	26 (83.87%)	1.56	0.46–5.25	0.472
Average monthly income (Thai Bath)					0.412
≤ 3,000	203	161 (79.31%)	Ref.		
3,001–9,000	210	177 (84.29%)	1.40	0.85–2.31	0.191
> 9,000	36	30 (83.33%)	1.30	0.51–3.34	0.580
Residential area					0.305
Rural	356	289 (81.18%)	Ref.		
Suburban	83	72 (86.75%)	1.52	0.76–3.02	0.235
Urban	10	7 (70.00%)	0.54	0.14–2.15	0.382
Numbers of Family members					0.141
1–2	73	63 (86.30%)	Ref.		
3–4	176	149 (84.66%)	0.88	0.40–1.92	0.740
≥ 5	200	156 (78.00%)	0.56	0.27–1.19	0.131
Type of cancer					0.129
Colorectal cancer	69	57 (82.61%)	1.43	0.68 – 3.00	0.344
Liver and bile duct cancer	46	35 (76.09%)	0.96	0.44–2.10	0.914
Lung cancer	17	13 (76.47%)	0.98	0.30–3.22	0.971
Breast cancer	135	120 (88.89%)	2.41	1.23–4.71	0.010
Cervical cancer	48	40 (83.33%)	1.50	0.64–3.55	0.351
Other types of cancer	134	103 (76.87%)	Ref.		
Elapsed time since the cancer diagnosis (years)					0.477
≤ 1	79	68 (86.08%)	Ref.		
2–4	137	109 (79.56%)	0.63	0.29–1.35	0.233
≥ 5	233	191 (81.97%)	0.74	0.36–1.51	0.403
Ongoing treatments					0.248
No	26	19 (73.08%)	Ref.		
Yes	423	349 (82.51%)	1.74	0.70–4.28	0.230
Healthcare facility for cancer treatment					0.025
Community hospital	67	45 (67.16%)	Ref.		
General hospital	223	191 (85.65%)	2.92	1.55–5.49	0.001
Regional hospital	91	76 (83.52%)	2.48	1.17–5.26	0.018
University hospital	22	19 (86.36%)	3.10	0.83–11.59	0.093
Other medical facility	46	37 (80.43%)	2.01	0.83–4.89	0.124

Table 2. Continued

Univariate analysis Factors	All participants (n = 449)	Vaccinated (at least two doses) (%)	Crude OR	95% CI	p-value
Health insurance					0.652
Universal Health Care	375	306 (81.60%)	Ref.		
Other medical insurance	74	62 (83.78%)	1.17	0.60–2.28	0.655
History of laboratory confirmation of COVID-19 infection					0.006
No	330	261 (79.09%)	Ref.		
Yes	119	107 (89.92%)	2.36	1.23–4.53	0.010
Comorbid diseases					0.693
No	324	267 (82.41%)	Ref.		
Yes	125	101 (80.80%)	0.90	0.53–1.52	0.691
Level of health literacy					0.008
Inadequate	19	10 (52.63%)	Ref.		
Problematic	221	178 (80.54%)	3.73	1.43–9.73	0.007
Sufficient	135	115 (85.19%)	5.18	1.87–14.32	0.002
Excellent	74	65 (87.84%)	6.50	2.08–20.30	0.001

vaccine among the patients in this study was 81.96%. The SARS-CoV-2 seroprevalence study in a Bangkok cancer in early 2021 found only four of 200 patients (2.00%) had received a COVID-19 vaccine (Ungtrakul et al., 2022). A study in Korea explored the vaccination rates of hospitalised patients with cancer at high risk of severe COVID-19 between April 18th and April 24th, 2022 (Nhamet et al., 2022). The percentage of patients who had received a second dose of COVID-19 vaccine was 82.8%. The study also found that vaccination rates were lower among elderly patients.

Cancer patients with excellent health literacy (OR_{Adj} = 7.23; 95% CI:2.11–24.71), sufficient health literacy (OR_{Adj} = 6.03; 95% CI:2.00–18.24), and problematic health literacy (OR_{Adj} = 3.88; 95% CI:1.37–11.00) were more likely to receive COVID-19 vaccine. A study in Bosnia and Herzegovina was conducted on the acceptance of COVID-19 vaccination and its associated factors among patients attending the oncology clinic at a university hospital Mostar (Marijanović et al., 2021). The study found that participants who answered that they had sufficient information about COVID-19 vaccines were more likely to intend to receive the COVID-19 vaccine (OR_{Adj} = 3.97; 95%CI:2.43–6.49). The authors also reported that the healthcare information could be effectively provided during medical consultations. It suggested that oncologists should obtain recent guidance published by oncology societies or organizations and

Table 3. Multivariable Analysis: Factors associated with COVID-19 vaccination status.

Predictors	All participants (n = 449)	Crude OR	[a]Adjusted OR	95% CI	p-values
Level of Health literacy					
Inadequate	19	Ref.	Ref.		
Problematic	221	3.73	3.88	1.37–11.00	0.011
Sufficient	135	5.18	6.03	2.00–18.24	0.001
Excellent	74	6.50	7.23	2.11–24.71	0.002
Marital status					
Single	48	Ref.	Ref.		
Married	307	2.58	2.90	1.37–6.14	0.005
Divorced / Widowed	94	1.68	2.23	0.92–5.39	0.076
Healthcare facilities for cancer treatment					
Community hospital	67	Ref.	Ref.		
General hospital	223	2.92	2.50	1.25–5.00	0.010
Regional hospital	91	2.48	2.19	0.98–4.92	0.057
University hospital	22	3.10	3.00	0.73–12.37	0.128
Other medical facility	46	2.01	1.92	0.75–4.93	0.175
History of laboratory confirmation of COVID-19 infection					
No	330	Ref.	Ref.		
Yes	119	2.36	2.37	1.19–4.71	0.014

[a]Adjusted for patient sex, age, residence, ongoing treatment status, and comorbid diseases.

collated the information to offer further advice so that patients with cancer can receive the best evidence-informed treatments (Yau et al., 2020).

In our study, married patients were more likely to be vaccinated (OR_{Adj} = 2.90;95% CI: 1.37–6.14), possibly because they were supported in information and encouragement by their families. It similar to a study was conducted about the external support associated with COVID-19 vaccination among Chinese breast cancer patients that who received positive support from surrounding people (OR_{Adj} =11.65; 95% CI: 7.57 - 17.91) (Wang et al., 2022).

We found that patients being treated at general hospitals were more likely to have been vaccinated (OR_{Adj} = 2.50; 95% CI:1.25–5.00), possibly because the hospital had a surgeon or oncologist with whom the cancer patients could consult and the distance to the general hospitals may be closer to their residences. A study was conducted about the external support associated with COVID-19 vaccination among Chinese breast cancer patients who had received a recommendation from a surgeon or oncologist (OR_{Adj} = 5.52; 95% CI: 3.50–8.71). The findings reveal a strong role of positive doctor suggestions (Wang et al., 2022). One of the few studies on the impact of the COVID pandemic on cancer care found that care was heavily reliant on oncologists' judgment to strike a balance between additional risks of COVID infection and the advantages of in-person treatment (Mandal et al., 2021)

Participants with a history of laboratory confirmation of COVID-19 infection were more likely to receive COVID-19 vaccine (OR_{Adj} = 2.37; 95% CI:1.19–4.71). It related with a study in Canada, a study focusing on the factors associated with timely COVID-19 vaccination in patients with cancer reported that those with COVID-19 infections were more likely to accept the vaccine than those without infections (OR_{Adj} = 1.12; 95% CI:1.10–1.15). Furthermore, this study discovered an association between having a COVID-19 infection before first dose and higher rates of complete vaccination (Powis et al., 2023).

The findings of our study will be useful for developing a more comprehensive COVID-19 vaccination implementation strategy for cancer patients in northeastern Thailand during the COVID-19 pandemic. Based on our findings, governments and health-related organisations should pay focus on patients' families and healthcare personnel, as they have additional opportunities to inform and convince patients about the benefits of vaccination.

There are a few limitations of this study. The work was carried out in northeastern Thailand, and the findings may not be generalisable to other areas. Furthermore, because official vaccine policies, vaccine availability, and COVID-19 pandemic conditions have changed over time, the study results may only be representative for the study period.

In conclusion, this study identified several patient-level factors associated with the COVID-19 vaccination level of patients with cancer patients in northeastern Thailand. The predictors of receiving COVID-19 vaccines were health literacy, being married, having ongoing treatment at the general hospital, and having a history of laboratory confirmation of COVID-19 infection. Therefore, enhancing healthcare provider awareness of these predictors could influent the COVID-19 vaccine uptake among patients with cancer.

Author Contribution Statement

Phichet Dapha developed and led the study, oversaw data collection, analysed the data, and wrote the draft manuscript. Surachai Phimha critically reviewed the study proposal. Nakarin Prasit assisted in interpreting the findings. Nopparat Senahad oversaw data management. All authors provided constructive criticism and contributed to the development of the research, analysis, and manuscript. All authors read the final version of the manuscript and approved its submission..

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