RESEARCH ARTICLE

Spatial Distribution of the Population at Risk of Cholangiocarcinoma in Chum Phaung District, Nakhon Ratchasima Province of Thailand

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Abstract

Background: Cholangiocarcinoma (CCA) is a serious health problem in Thailand, particularly in northeastern and northern regions, but epidemiological studies are scarce and the spatial distribution of CCA remains to be determined. A database for the population at risk is required for monitoring, surveillance and organization of home health care. This study aim was to geo-visually display the distribution of CCA in northeast Thailand, using a geographic information system and Google Earth. Materials and Methods: A cross-sectional survey was carried out in 9 sub-districts and 133 villages in Chum Phuang district, Nakhon Ratchasima province during June and October 2015. Data on demography, and the population at risk for CCA were combined with the points of villages, sub-district boundaries, district boundaries, and points of hospitals in districts, then fed into a geographical information system. After the conversion, all of the data were imported into Google Earth for geo-visualization. Results: A total of 11,960 from 83,096 population were included in this study. Females and male were 52.5%, and 47.8%, the age group 41-50 years old 33.3%. Individual risk for CCA was identifed and classified by using the Korat CCA verbal screening test as low (92.8%), followed by high risk (6.74%), and no (0.49%), respectively. Gender (X^2-test=1143.63, p-value= 0.001), age group (X^2-test==211.36, p-value=0.0001), and sub-district (X^2-test=1471.858, p-value=0.0001) were significantly associated with CCA risk. Spatial distribution of the population at risk for CCA in Chum Phuang district was viewed with Google Earth. Geo-visual display followed Layer 1: District, Layer 2: Sub-district, Layer 3: Number of low risk in village, Layer 4: Number of high risk in village, and Layer 5: Hospital in Chum Phuang District and their related catchment areas. Conclusions: We present the first risk geo-visual display of CCA in this rural community, which is important for spatial targeting of control efforts. Risk appears to be strongly associated with gender, age group, and sub-district. Therefor, spatial distribution is suitable for the use in the further monitoring, surveillance, and home health care for CCA.

Keywords: Spatial distribution - population at risk - cholangiocarcinoma - Nakhon Ratchasima - Thailand

Introduction

Cholangiocarcinoma (CCA) is known to be one of the most common causes of cancer related to death in Thailand where is the highest incident of the world (Green et al., 1991; Sripa et al., 2007; Shin et al., 2010). CCA is a neoplasm that involves the epithelial cells of the bile duct. This disease is difficult to have early diagnosis, as most symptoms present late in the disease course. In addition, CCA is considered to be an incurable and rapidly

lethal disease unless all the tumors can be fully resected. Three-year survival rates of 35% to 50% are achieved only in a subset of patients who have negative histological margins at the time of surgery (Akamatsu et al., 2011). To e encourage patients to see health personnel at early stage is very important (Thunyaharn et al., 2013).

The high mortality rate of CCA was reported in the northeast areas where found frequently of *Opisthorchis viverrini* infection (Sripa et al., 2011). Recently, *O. viverrini* has been classified as Type 1 carcinogens by

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the International Agency for Research on Cancer, World Health Organization (WHO) (IARC, 1994). Mortality rate of liver cancer and *O. viverrini* infection rate in different regions of Thailand has been reported and found that Nakhon Ratchasima province has 13.67-16.2 per 100,000 populations (Sripa et al., 2008). In addition, the distribution *O. viverrini* infection in Nakahon Ratchasima province has been reported, the prevalence of survey in 2009 was 4.6% (Sitthithaworn et al., 2012). A total of 1,168 stool samples were obtained from 516 males and 652 females. Stool examination showed that 2.48% were infected with *O. viverrini* (Kaewpitoon et al., 2012c).

Recently, we have been utilized the GIS and Google Earth™ for distribution mapping of CCA in Satuek district, Buriram, Thailand, during a 5-year period (2008-2012), and found that the GE production process is very simple and easy to learn. It is suitable for the user in the further CCA management strategy (Rattanasing et al., 2015). Rujirakul et al. (2015) have been investigated the human behavior, and environmental factors influencing the distribution in Surin Province of Thailand. The combination of GIS and statistical analysis can help simulate the spatial distribution and risk areas of liver fluke, and thus may be an important tool for future planning of prevention and control measures. Therefore, the spatial distribution of the population at risk for CCA is conducted in Chum Phuang district, Nakhon Ratchasima province, Thailand, using geographic information system and Google Earth. This data is useful for further monitoring, surveillance, and home visit the population at risk.

Materials and Methods

Study location and population

The study was conducted in Chum Phuang district, Nakhon Ratchasima province, northeast Thailand, between June and October 2015. The study protocol was approved by Suranaree University Ethical Review Committee, EC58-48. Chum Phuang is a district in the eastern part of Nakhon Ratchasima province, located in coordinates: 15°20'56"N 102°44'31"E. Neighboring districts are (from the north clockwise) Prathai, Mueang Yang and Lam Thamenchai of Nakhon Ratchasima Province, Lam Plai Mat of Buriram Province, and Huai Thalaeng and Phimai of Nakhon Ratchasima again. The district is subdivided into 9 sub-districts. Chum Phuang is the only township of the district, covering parts of the Chum Phuang sub-district. There are further 9 sub-district administrative organizations, including Chum Phuang, Prasuk, Tha Lat, Sarai, Talat Sai, Non Rang, Non Lak, Non Tum, and Non Yo. Chum Phuang district is coverage areas 540.6 Kilometer2 (208.7 sq mi), and has 83,096 populations. A total of 11,960 populations who have age over 35 years old, was purposive selected and completed the verbal screening.

Populations at risk for CCA, were screened by using Korat CCA verbal screening test (KCVST) which contained the history with (1) opisthorchiasis (2) under-cooked fish consumption, (3) praziquantel used (4) cholangitis or cholecystitis, (5) relative family with CCA (6) naïve northeastern people, (7) agriculture, and (8)

alcohol consumption. Scores were summarized following 1+2+3+4+5+6+7+8, and calculated the population at risk; none (0 point), low (1-4 point), and high risk (5-8 point) (Table 1).

Software, data collection and management

Software were used in this study, including Microsoft excel, ArcGIS 10.2, and Google Earth. Spatial database was contained the point of villages, sub-district boundaries, district boundaries, and point of hospital in Chum Phuang district. Attribute database was contained the populations at risk for CCA; low and high risk, opisthorchiasis, and CCA. Data management were collected the spatial database and then tranfered to WGS84 UTM ZONE 48. Village point, where had the populations at risk for CCA, opisthorchiasis, abnormal bile duct, and CCA, were used to analyze and calculate with ArcGIS 10.2. After the conversion, all of the data were imported into Google Earth (GE) using online web pages www.earthpoint.us. This web pages using HTML codes (village point was a primary key) to export the coordinate to .kml format that can be recognized by GE (Figure 1). Geovisual display of the population at risk for CCA on the Google Maps in this study include 5 layers, for each layer using could be click scroll and choos ☑ (Figure 2); layer 1; district, layer 2; sub-district, layer 3; low risk, layer 4; high risk, layer 5; hospital in Chum Phuang District.

Results

A total of 11,960 population from 83,096 population, were included in this study, indentified to gender; male (47.81%), female (52.52%). The majorities of population were age group 41-50 years old (33.32%), followed by 51-60 years old (33.04%), and 61-70 years old (16.68%). The most of them was habited in Ta Lat (17.78%), and followed by Prasuk (14.93%), and Tala Sai (12.80%). Population at risk was identifed to low risk (92.77%), and followed by high risk (6.74%), and none of risk (0.49%), respectively. Gender (X^2-test=1143.63, p-value= 0001), age group (X^2-test==211.36, p-value=0.0001), and sub-district (X^2-test=1471.858, p-value=0.0001) were
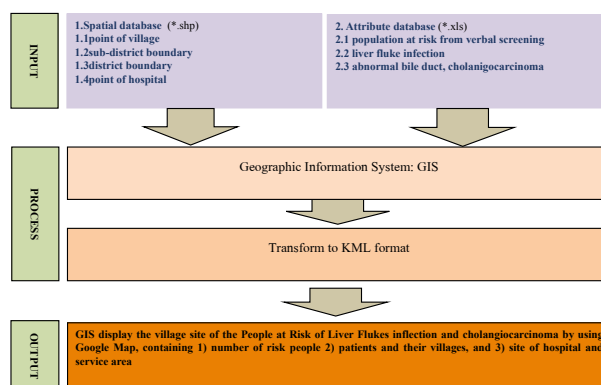

Figure 1. Diagrammatic of Utilized Geographic Information System and Google Map for Monitoring and Surveillance the Population at Risk of Cholangiocarcinoma in Chum Phuang District, Nakhon Ratchasima Province, Thailand

statistical significant associated to CCA risk (Table 1).

Spatial distribution of the population at risk for CCA in Chum Phuang district has been viewed in Google Earth following https://www.google.com/maps/d/viewer?hl=th&authuser=0&mid=zG-BgiD3m1lo.kJ_lZC7ZtldU (Figure 3, 4). Geo-visual display was followed;

Layer 1 Chum Phuang district (Number of Sub District); Attributed data was displayed the district border with 9 sub-districts and 133 villages. Google map was displayed village location and the symbol of number of the population at risk in each village.

Layer 2 Sub-district (Number of Village); Attributed data was displayed the sub-district border with 9 sub-districts. Google map was displayed village location and the symbol of number of the population at risk in each village within sub-order of sub-district.

Layer 3 Number of low risk in village (Number of Village); Attributed data was displayed the village location. Google map was displayed village location and the symbol of number of the population at low risk in each village, 63 villages, within the sub-order of sub-district.

Figure 2. Ranking and Attribute Data of Population at Risk for Cholangiocarcinoma in Chum Puang District, Nakhon Ratchasima Province, Thailand
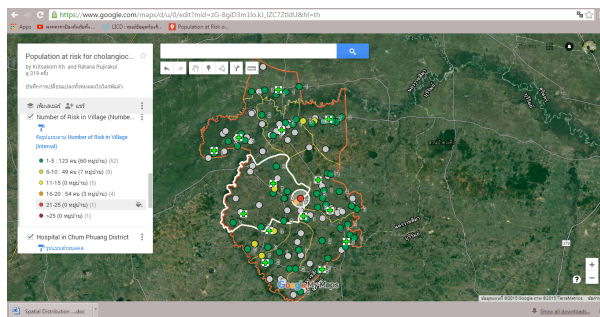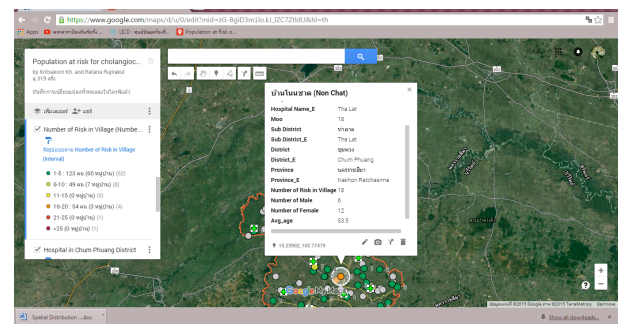

Figure 3. Geo-visual Display of Population at Risk for Cholangiocarcinoma in Chum Phuang District, Nakhon Ratchasima Province, Thailand, Using Google Map

Figure 4. Geo-visual Display of Population at Risk for Cholangiocarcinoma of Village in Chum Phuang District, Nakhon Ratchasima Province, Thailand, by Using Google Map

Table 1. Population at Risk for Cholangiocarcinoma in Chum Phuang District, Nakhon Ratchasima Province, Thailand, Using Korat CCA Verbal Screening Test

| Characteristics | Risk for CCA | | | | | | Total | |
| | None | | Low | | High | | | |
	n	%	n	%	n	%	n	%
Gender	59	0.49	11,131	92.77	809	6.74	11,999	100.00
Male	29	0.24	5,191	43.26	498	4.15	5,718	47.81
Female	30	0.25	5,940	49.50	311	2.59	6,281	52.52
Pearson Chi-Square=1143.63, p-value= 0001								
Age group	46	0.38	11,155	92.97	798	6.65	11,999	100.00
<40	4	0.03	1,235	10.29	65	0.54	1,304	10.87
41-50	10	0.08	3,719	30.99	269	2.24	3,998	33.32
51-60	13	0.11	3,636	30.30	315	2.63	3,964	33.04
61-70	12	0.10	1,865	15.54	125	1.04	2,002	16.68
>70	7	0.06	700	5.83	24	0.20	731	6.09
Pearson Chi-Square=211.36, p-value=0.0001								
Sub-district	46	0.38	11,155	92.97	798	6.65	11,999	100.00
Chum Phuang	18	0.15	1,242	10.35	42	0.35	1,302	10.85
Tala Sai	0	0.00	1,454	12.12	82	0.68	1,536	12.80
Ta Lat	9	0.08	1,924	16.03	201	1.68	2,134	17.78
Prasuk	5	0.04	1,728	14.40	59	0.49	1,792	14.93
Salai	3	0.03	525	4.38	114	0.95	642	5.35
Nong Luk	0	0.00	719	5.99	42	0.35	761	6.34
Non Tum	7	0.06	1,357	11.31	83	0.69	1,447	12.06
Non Yo	3	0.03	915	7.63	81	0.68	999	8.33
Non Rang	1	0.01	1,290	10.75	94	0.78	1,385	11.54
Fisher's Exact Test= 1471.858, p-value=0.0001								

Soraya J Kaewpitoon et al

Layer 4 Number of high risk in village (Number of Village); Attributed data was displayed the villages with the each ranking risk, 226 persons and 70 villages. Google map was displayed village location and the symbol of number of the population at risk in each village within sub-order of sub-district.

Layer 5 Hospital in Chum Phuang District; Attributed data was displayed the hospital in this district. Google map was displayed hospital location and the related catchment areas.

Discussion

CCA is still a serious public health problem in Nakhon Ratchasima province of Thailand. Mortality rate of liver cancer has been reported and found that Nakhon Ratchasima province has 13.67-16.2 per 100,000 populations (Sripa et al., 2011). Worldwide, it has an annual incidence rate of 1-2 cases per 100,000 (Landis et al., 1998; Patel, 2002). Here we active surveillance by using verbal screening test and found that a total of 809 (6.74%) the population at risk for CCA, was a high risk group. The majorities of population were age group 41-50 years old, followed by 51-60 years old, and 61-70 years old. The most of them was habited in Ta Lat, and followed by Prasuk, and Tala Sai. In addition, we found that gender, age group, and sub-district were statistical significant associated to CCA risk. Previously study reported that *O. viverrini*, the one caused of CCA, found frequently in this district particularly in the elderly age and male (Kaewpitoon et al., 2012c).This figure indicates that CCA is still a major problem in Chum Phuang district, Nakhon Ratchasima province particularly in the rural communities.

The utilized the GIS and Google Earth™ for distribution mapping of CCA has been reported in Satuek district, Buriram, Thailand, and found that the GE production process is very simple and easy to learn. It is suitable for the user in the further CCA management strategy (Rattanasing et al., 2015). Furthermore, the combination of GIS and statistical analysis can help simulate the spatial distribution and risk areas of liver fluke in Surin proivince, Thailand. Here we have shown the spatial distribution of the population at risk for CCA in Chum Phuang district. The 5 layers have been applied for geo-visual display of CCA, briefly, layer 1: Chum Phuang District; displayed the district border with 9 sub-districts and 133 villages. Layer 2: Sub District; displayed the sub-district border with 9 sub-districts. Layer 3 Number of low risk in village; displayed the village location and the population at low risk in each village, 63 villages, within the sub-order of sub-district. Layer 4: Number of high risk in village; displayed the villages with the each ranking risk, 226 persons and 70 villages. Layer 5: Hospital in Chum Phuang District; displayed the hospital in this district, and the related catchment areas. This geo-visual display is used for further monitoring, surveilance, and long-term health care.

We present the first risk geo-visual display of CCA in Chum Phuang district, Nakhon Ratchasima province, which is important for spatial targeting of control efforts. Population at risk appears to be strongly associated with gender and age group in this district. Therefor, spatial distribution is suitable for the use in the further monitoring, surveillance, and home health care for CCA.

Acknowledgements

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