

Geographic Distribution of Patients with Congenital Craniofacial Malformations at Srinagarind Hospital between 2005 and 2014

Kaewjai Thepsuthammarat PhD*, Rumpan Pattaranit MSc**,
Vasana Chantachum BSc**, Chainarong Songsung BSc**,
Sanguansak Thanaviratnanich MD, MSc, FRCOT, FICS***, Bowornsilp Chowchuen MD, MBA****

* *Clinical Epidemiology Unit, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand*

** *Medical Records and Statistics Department, Srinagarind Hospital, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand*

*** *Department of Otorhinolaryngology, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand*

**** *Department of Surgery, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand*

Background: Although the prevalence of newborns with cleft lip/cleft palate in northeastern Thailand is high and the region has a center of excellence for craniofacial deformities at Srinagarind Hospital, Khon Kaen University, there has to date been no geographic epidemiologic study of congenital craniofacial malformations (CCM) in Thailand.

Objective: To study the geographic distributions of patients with CCM.

Material and Method: This was a descriptive retrospective study conducted using the medical records of patients with CCM who attended Srinagarind Hospital, Khon Kaen University between 2005 and 2014. The geographic information system (GIS) was used to visualize the distribution of patients.

Results: There were 4,721 out-patients and 2,922 in-patients (52.5% male). Most of the patients (48.8%) were between 1 and 15 years of age. Most of the patients were in Khon Kaen (23.8%); mostly in the central and sub-district of Khon Kaen municipality. Overall, the highest prevalence of CCM was for patients with cleft palate with cleft lip (16.2%). The highest prevalence in Khon Kaen was for congenital malformations of the eyelid, lacrimal apparatus, and orbit (21.6%).

Conclusion: Most patients attending Srinagarind Hospital lived in urban Khon Kaen, probably because of (a) accessibility (b) its being a center for craniofacial deformities and (c) its being designated the nearest health care delivery center. The results of the GIS analysis will be used for planning healthcare accessibility and resource utilization for congenital craniofacial malformations.

Keywords: Geographic information system, Congenital craniofacial malformations, Tawanchai Center, Srinagarind Hospital

J Med Assoc Thai 2017; 100 (Suppl. 6): S94-S101

Full text. e-Journal: <http://www.jmatonline.com>

Congenital craniofacial malformations (CCM) are one of the most common birth defects. CCMs have medical, psychological, social, and financial implications for affected individuals and their families. The incidence of new cleft lip and palate (CLP) patients has the highest birth incidence among Asians and Amerindians (1.0 to 3.9 per 1,000 births)^(1,2). In Thailand, the incidence approaches 2,081 cases per year⁽¹⁾. The ratio of new babies born with cleft lip/cleft palate in northeastern Thailand is 2.49 per 1,000⁽³⁻⁵⁾.

Our study was conducted for a period of 12 months between 2003 and 2004 for infant deliveries with CLP and associated risk factors in all 6 provincial hospitals from the 4 regions of Thailand. Phitsanulok, Saraburi, and Khon Kaen had a high birth incidence for CLP of 2.01, 1.69, and 1.66 per 1,000 live births, respectively. The overall birth incidence was 1.51 per 1,000 live births⁽⁶⁾. The variable incidence of CLP may reflect the incomplete accuracy of case ascertainment. Prevalence also varies with geographic information, economics status, genes, and social environments⁽¹⁾.

Multidisciplinary approaches for the management of CCM are essential. Srinagarind Hospital is a supra-tertiary, university hospital that serves the healthcare needs for the whole northeastern region. The Center for Cleft Lip/Palate and Craniofacial

Correspondence to:

Chowchuen B, Division of Plastic Surgery, Department of Surgery, Faculty of Medicine, Khon Kaen University, Thailand, Phone: +66-43-363123, Fax: +66-43-202558
E-mail: bowcho@kku.ac.th

Deformities, under the Tawanchai Royal Project, is a centre of excellence. The centre provides a full spectrum of specialties and levels of care including holistic complex triaging, administration and coordination of multi-inter-disciplinary teams for patients with CCM, especially CLP. This is particularly important as the incidence of CLP in the provinces around Khon Kaen is high^(4,5).

The use of the geographic information system (GIS) requires a multi-disciplinary approach for collecting spatial distribution data, presenting it on maps, and aiding interpretation through visual cues. The use of GIS helps improve patient care through planning outreaches, community-based interdisciplinary treatment, referrals, and scheduling follow-up and follow-on treatments^(5,7-9). Since there has been no research conducted on the geographic distribution of CCM in Thailand, we conducted GIS research to determine the district level distribution of patients with CCM who visited Srinagarind Hospital and registered at the Tawanchai Center between October 2004 and September 2014.

Objective

To adapt the GIS for assessing the district level distribution of patients with CCM.

Material and Method

We conducted a descriptive retrospective study using medical data between 2005 and 2014 retrieved from the Medical Records and Statistics Department of Srinagarind Hospital, Faculty of Medicine, Khon Kaen University, Thailand. This included the database from the Tawanchai Center under

the aegis of the National Health Security Office (Area 7-Khon Kaen).

The data comprised the records of patients with CCM (ICD-10, Q00-38, Q67, Q75). Map Window GIS version 4.8.8 software-an instrument for geoinformatics-was used to illustrate the district layer, distribution of the patients. Stata version 10 was used to describe the data (number and percentages).

This study was approved by the Ethics Committee of Khon Kaen University (HE581386).

Results

There were 4,721 out-patients with CCM and 2,922 cases admitted for management in the hospital. There were more male patients than females and most were between 1 and 15 years of age (Table 1). The patients came from all provinces of the northeast, as well as neighboring countries (viz., Lao People's Democratic Republic) and two from Western countries (Table 2).

The top five patient addresses were Khon Kaen, Maha Sarakham, Kalasin, Roi-Et, and Udon Thani. This distribution is similar to the rank for inpatients. Every district (but not every sub-district) in the top 10 provinces represented had at least one patient with CCM (Fig. 1) (Table 3). Most patients of the top five provinces lived in the urban districts (i.e., Amphoe Muang). At the sub-district level, the majority of sub-districts represented were near the central district (e.g., Tambon Nai Muang in Amphoe Muang Khon Kaen, Tambon Talat in Amphoe Muang Maha Sarakham) (Table 4).

Patients with cleft palate with cleft lip (Q37) constituted the maximum prevalence, followed by

Table 1. Baseline characteristics of the patients

	Total		Number of admissions	
	n	%	n	%
Total	4,721	100	2,922	61.9
Sex				
Male	2,479	52.5	1,583	63.9
Female	2,242	47.5	1,339	59.7
Age (Years)				
<1	1,538	32.6	1,168	75.9
1-15	2,304	48.8	1,350	58.6
16-30	503	10.7	260	51.7
31-45	179	3.8	76	42.4
45-60	114	2.4	43	37.7
>60	83	1.8	25	30.1

Table 2. Geographic distribution by province

Province	Total		Number of Admission	
	n	Col %	n	Row %
National	4,721	100	2,922	61.9
Khon Kaen	1,124	23.8	630	56.0
MahaSarakham	432	9.2	260	60.2
Kalasin	416	8.8	254	61.1
Roi Et	407	8.6	282	69.3
UdonThani	321	6.8	194	60.4
Chaiyaphum	299	6.3	168	56.2
Sakon Nakhon	265	5.6	186	70.2
Loei	262	5.5	192	73.3
Nong Bua Lam Phu	178	3.8	124	69.7
Nong Khai	135	2.9	86	63.7
Other in northeast*	746	15.8	458	61.4
Other part region**	83	1.8	54	65.1
Loas	49	1.0	32	65.3
Other country***	4	0.1	2	50.0

Number of patients

* Buriram 118, Beung Gaan 104, Nakhon Ratchasima 100, Nakhon Phanom 95, Ubon Ratchathani 68, Yasothon 68, Mukdahan 67, Am Nat Charoen 44, Si Sa Ket 41, Surin 40, Sa Kaeo 1

** North: Lampang 1, Nakhon Sawan 2, Uthaitani 1, Tak 1, Phitsanulok 1, Phichit 2, Phetchabun 35; Central: Bangkok Metropolis 10, Samutprakan 2, Nonthaburi 4, Pathumthani 5, Saraburi 1, Chonburi 5; Central: Rayong 2, Trat 1, Prachinburi 1, Nakhon Nayok 1, Suphanburi 2, Nakhon Pathom 1, Samut Sakhon 1; South: Chumphon 1, Songkhla 1, Trang 1, Narathiwat 1

*** Vietnam 1, England 1, America 1, No data 1

Table 3. Number of districts and sub-districts (Tambon) by top 10 provinces represented in northeastern Thailand and congenital malformations of craniofacial disease

Province	Total		With congenital malformations of craniofacial	
	District	Tambon	District	Tambon
NE region	159	1,278	159	1,023
Khon Kaen	25	200	25	181
MahaSarakham	13	134	13	116
Kalasin	18	135	18	114
Roi Et	20	193	20	137
UdonThani	20	156	20	114
Chaiyaphum	16	124	16	86
Sakon Nakhon	18	125	18	101
Loei	14	90	14	75
Nong Bua Lam Phu	6	59	6	53
Nong Khai	9	62	9	46

congenital malformations of the eyelid, lacrimal apparatus, and orbit (Q10), cleft lip (Q36), cleft palate (Q35), other congenital malformations of face and neck

(Q18), and congenital lens malformations (Q12) (Table 5). The distribution of diagnoses was similar among the top five provinces.

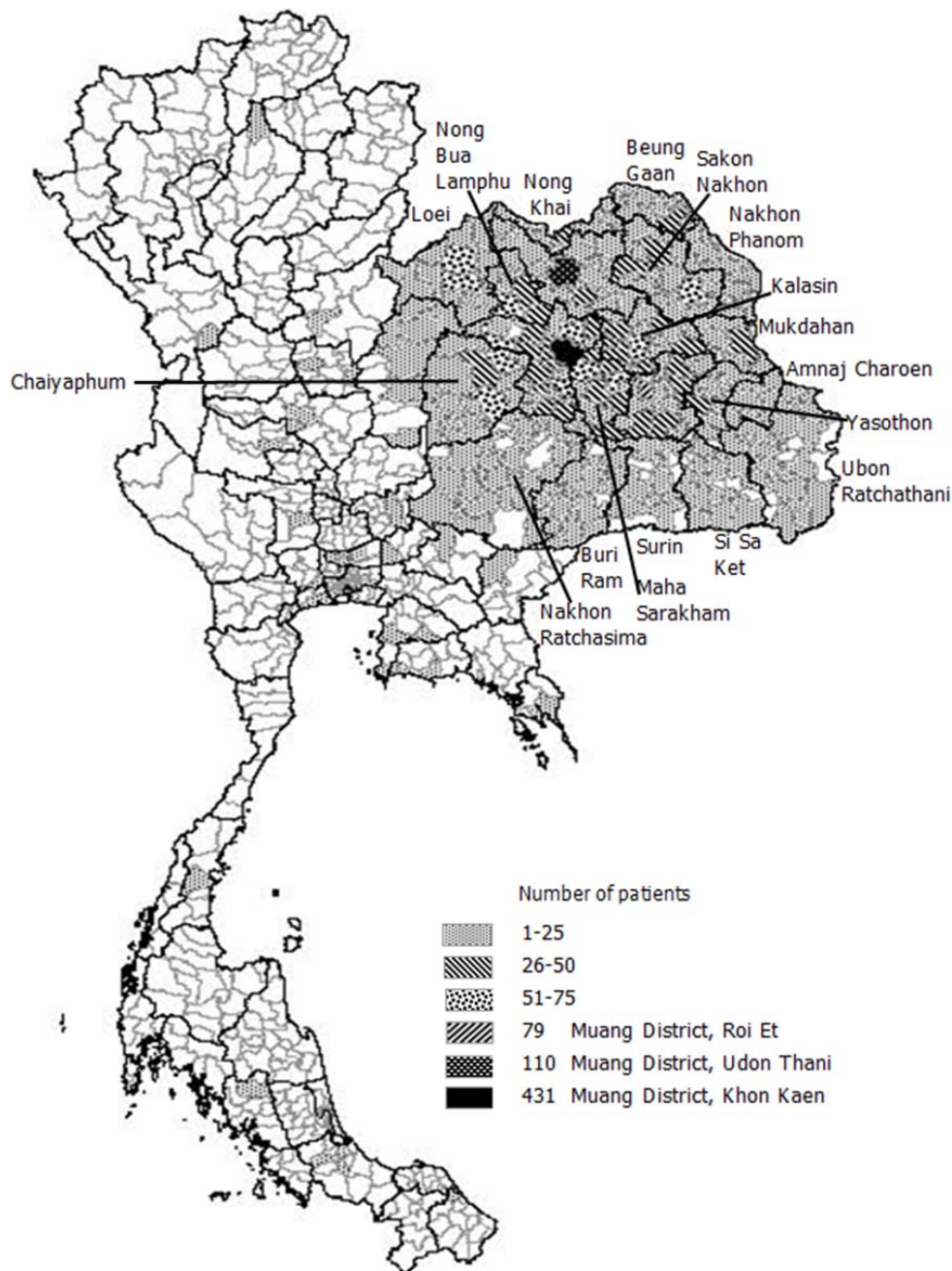


Fig. 1 Geographic intensity distribution of patients with congenital craniofacial malformations attending Srinagarind Hospital between 2005 and 2014.

Discussion

The prevalence of patients with CCM has apparently risen over the last decade⁽⁴⁾. The majority of patients have cleft palate with cleft lip (Q37). Patients come from all over Thailand including nearly all sub-districts of the northeastern region. The relatively small numbers from some sub-districts might be due to poor

accessibility to healthcare⁽¹⁰⁾. The majority of cases in Khon Kaen had congenital malformations of the eyelid, lacrimal apparatus and orbit (Q10).

This study demonstrated that most patients lived in municipalities. Most from the district layer lived in central (Amphoe Muang) Khon Kaen, or in the sub-district (Tambon Nai Muang), which is an extension of

Table 4. Top three districts and top three sub-districts (Tambon) in each district of the top five provinces represented in the northeastern region

District	n	%	Tambon (Number of patients)		
			1	2	3
KhonKaen (n = 1,124)					
1) Muang n	431	38.3	NaiMuang 157	Sila 79	Ban Pet 62
2) Chum Phae n	73	6.5	Chum Phae 15	NongPhai 10	Wang HinLat 8
3) Nam Phong n	63	5.6	ThaKrasoem 8	Nam Phong 7	Ban Kham 7
MahaSarakham (n=432)					
1) Muang n	73	16.9	Talat 27	Khwao 9	Tha Song Khon 6
2) KosumPhisai n	64	14.8	Hua Khwang 8	Khwao Rai 7	Nong Kung Sawan 6
3) WapiPathum n	47	10.9	Hua Ruea 7	NongSaeng 6	Khok Si Thonglang 6
Kalasin (n=416)					
1) Muang n	73	17.5	Kalasin 31	BuengWichai 6	Phai 6
2) Kamalasai n	39	9.4	Kamalasai 12	Chao Tha 9	NongPaen 5
3) Kuchinarai n	39	9.4	Bua Khao 12	Na Kham 4	Sam Kha 4
Roi Et (n =407)					
1) Muang n	79	19.4	NaiMuang 18	NueaMuang 15	RopMuang 11
2) Selaphum n	45	11.1	Klang 6	Na Muang 6	PhuNgoen 5
3) Phon Thong n	36	8.8	Um Mao 7	Pho Thong 6	Wang Samakkhi 5
UdonThani (N=321)					
1) Muang n	110	34.3	MakKhaeng 42	Non Sung 9	Nong Bua 7
2) Kumphawapi n	26	8.1	Phan Don 6	Tum Tai 5	Tha Li 4
3) Ban Dung n	23	7.2	Thon Na Lap 3	Na Mai 3	Ban Dung 3

the central urban area⁽¹⁰⁾. The high prevalence in Khon Kaen might be explained by the easy accessibility of Khon Kaen patients to Srinagarind Hospital and the Center for Cleft Lip/Palate and Craniofacial Deformities, which also happens to be the only centre with a multidisciplinary team for CCM in northeastern Thailand⁽¹¹⁾. Even if patients are operated on in other hospitals, they will be referred to us for other management, including speech therapy, child development, orthognathics, psychiatrics, and orthodontics.

Conclusion

The GIS analysis revealed that most of the patients with CCM who have received treatment at Srinagarind Hospital lived relatively nearby, particularly in the municipality. Most of the patients had congenital malformations of the eye, ear, face and neck. A center of excellent (credibility and expertise), location (easy to access), and health's system might be the causes that the municipal patients came and other hospitals referred to us but people in remote areas still cannot reach the center. The planning outreach, receiving

Table 5. Number and percentage of patients by primary diagnosis and top five provinces in north eastern region

primary diagnosis	Total	Top 5 province in north eastern region				
	n (%)	KKN	MKM	KSN	RET	UDN
Q37 Cleft palate with cleft lip	766 (16.2)	140 (12.5)	70 (16.2)	60 (14.4)	85 (20.9)	58 (18.1)
Q10 Congenital malformations of eyelid, lacrimal apparatus and orbit	704 (14.9)	243 (21.6)	58 (13.4)	73 (17.6)	47 (11.6)	33 (10.3)
Q36 Cleft lip	470 (10.0)	99 (8.8)	59 (13.7)	39 (9.4)	67 (16.5)	19 (5.9)
Q35 Cleft palate	406 (8.6)	76 (6.8)	49 (11.3)	39 (9.4)	37 (9.1)	32 (10.0)
Q18 Other congenital malformations of face and neck	375 (7.9)	121 (10.8)	42 (9.7)	18 (4.3)	27 (6.6)	27 (8.4)
Q12 Congenital lens malformations	367 (7.8)	82 (7.3)	17 (3.9)	42 (10.1)	31 (7.6)	25 (7.8)
Q17 Other congenital malformations of ear	228 (4.8)	30 (2.7)	21 (4.9)	24 (5.8)	20 (4.9)	26 (8.1)
Q38 Other congenital malformations of tongue, mouth and pharynx	199 (4.2)	61 (5.4)	20 (4.6)	12 (2.9)	12 (3.0)	18 (5.6)
Q04 Other congenital malformations of brain	192 (4.1)	42 (3.7)	21 (4.9)	25 (6.0)	16 (3.9)	8 (2.5)
Q02 Microcephaly	166 (3.5)	29 (2.6)	13 (3.0)	18 (4.3)	12 (3.0)	19 (5.9)
Q75 Other congenital malformations of skull and face bones	127 (2.7)	44 (3.9)	5 (1.2)	13 (3.1)	7 (1.7)	10 (3.1)
Q15 Other congenital malformations of eye	126 (2.7)	27 (2.4)	5 (1.2)	9 (2.2)	8 (2.0)	8 (2.5)
Q01 Encephalocele	115 (2.4)	17 (1.5)	10 (2.3)	10 (2.4)	12 (3.0)	2 (0.6)
Q13 Congenital malformations of anterior segment of eye	95 (2.0)	29 (2.6)	6 (1.4)	9 (2.2)	3 (0.7)	7 (2.2)
Q03 Congenital hydrocephalus	91 (1.9)	29 (2.6)	9 (2.1)	7 (1.7)	6 (1.5)	5 (1.6)
Q11 Anophthalmos, microphthalmos and macrophthalmos	87 (1.8)	22 (2.0)	6 (1.4)	5 (1.2)	3 (0.7)	5 (1.6)
Q67 Congenital musculoskeletal deformities of head, face, spine and chest	57 (1.2)	11 (1.0)	5 (1.2)	6 (1.4)	6 (1.5)	6 (1.9)
Q16 Congenital malformations of ear causing impairment of hearing	55 (1.2)	4 (0.4)	3 (0.7)	2 (0.5)	3 (0.7)	5 (1.6)
Q14 Congenital malformations of posterior segment of eye	49 (1.0)	9 (0.8)	9 (2.1)	2 (0.5)	3 (0.7)	3 (0.9)
Q30 Congenital malformations of nose	42 (0.9)	8 (0.7)	2 (0.5)	3 (0.7)	2 (0.5)	5 (1.6)
Q00 Anencephaly and similar malformations	4 (0.1)	1 (0.1)	2 (0.5)	0 (0.0)	0 (0.0)	0 (0.0)
Total	4,721	1,124	432	416	407	321

KKN = KhonKaen, MKM = MahaSarakam, KSN = Kalasin, RET = RoiEt, UDN = UdonThani

medical care, and resource allocation should be expanded, especially since there has been an upward trend of patients with CCM. The use of GIS is helpful for investigating and planning cleft care management⁽⁶⁾.

What is already known on this topic?

Thailand has a high prevalence of CLP (Q35-Q37) in northeastern region.

What this study adds?

This is among the first studies to use the GIS distribution of CCM in northeastern Thailand. The patients came from the whole country, not just the northeastern region. Most of the patients lived in or nearby urban areas. The geographic distribution of patients will help in planning services, referrals and continuation of care. Overall the highest prevalence of

CCM was cleft palate with cleft lip (Q37), but in Khon Kaen congenital malformations (of the eyelid, lacrimal apparatus and orbit (Q10)) were more prevalent. This data will help in planning at the cleft management center.

Acknowledgements

The authors thank (a) the patients and their families for their participation (b) the staff for their assistance and devotion and (c) Mr. Bryan Roderick Hamman for assistance with the English-language presentation.

Potential conflicts of interest

The study was supported by the Center of Cleft Lip-Cleft Palate and Craniofacial Deformities, Khon Kaen University, under Tawanchai Royal Grant Project.

References

1. World Health Organization. Report of a WHO meeting on International Collaborative research on craniofacial anomalies. Geneva; 2-4 December 2004.
2. Panamonta V, Pradubwong S, Panamonta M, Chowchuen B. Global birth prevalence of orofacial clefts: A systematic review. *J Med Assoc Thai* 2015; 98 (Suppl 7):S11-21.
3. Ruangsitt C, Phraserthsang P, Banpho Y, Lamduan W, Glathamnuay S, Nuwantha A. Incidence of cleft lip and cleft palate in three hospitals in Khon Kaen. Khon Kaen: Department of Orthodontics, Faculty of Dentistry, Khon Kaen University; 1993.
4. Lekbunyasins O, Pradubwong S, Chantachum V, Udomtanassup S, Chowchuen B. Statistics of patients with cleft lip and palate in Srinagarind Hospital, 1984-2007. *Srinagarind Med J* 2009; 24: 240-6.
5. Pradubwong S, Lekbunyasins O, Chantachum V, Udomtanassup S, Simmalee K, Chowchuen B. Application of Geographic Information System (GIS) for management of cleft lip-palate care at the Tawanchai Cleft Center. *J Med Assoc Thai* 2010; 93 (Suppl 4): S58-62.
6. Chowchuen B, Thanaviratananich S, Chichareon V, Kamolnate A, Uewichitrapochana C, Godfrey K. A multisite study of oral clefts and associated abnormalities in Thailand: The epidemiologic data. *Plast Reconstr Surg Glob Open* 2016; 3: e583.
7. Cromley EK, McLafferty SL. GIS and public health. 2nd ed. New York: Guilford Press; 2012.
8. Scotch M, Parmanto B, Gadd CS, Sharma RK. Exploring the role of GIS during community health assessment problem solving: experiences of public health professionals. *Int J Health Geogr* 2006; 5: 39.
9. McLafferty SL. GIS and health care. *Annu Rev Public Health* 2003; 24: 25-42.
10. Virarat P, Ritthagol W, Limpattamapanee K. Epidemiologic study of oral cleft in Maharat Nakhon Ratchasima Hospital between 2005-2009. *J Thai Assoc Orthod* 2010; 9: 3-13.
11. Pradubwong S. Interdisciplinary care on timing of cleft lip/palate. *Srinagarind Med J* 2007; 22: 1-6.

การกระจายทางภูมิศาสตร์ในผู้ป่วยที่มีความพิการแต่กำเนิดบนใบหน้าและกะโหลกศีรษะที่มารับการรักษาที่โรงพยาบาล
ศรีนครินทร์ ปีงบประมาณ พ.ศ. 2548-2557

แก้วใจ เทพสุธรรมรัตน์, รำพรรณ ภักธนิตย์, วาสนา จันทะชุม, ชัยณรงค์ ทรงศักดิ์, สงวนศักดิ์ ธนาวิรัตน์านิจ, บวรศิลป์ เชาวนชื่น

ภูมิหลัง: ถึงแม้ว่าทารกแรกเกิดที่มีภาวะปากแหว่งเพดานโหว่มีอัตราส่วนสูงและโรงพยาบาลศรีนครินทร์ เป็นที่ตั้งของศูนย์ความเป็นเลิศด้านความพิการบนใบหน้าแต่ก็ยังไม่พบว่ามีการศึกษาการกระจายทางภูมิศาสตร์ ทางระบาดวิทยาของผู้ป่วยที่มีความพิการแต่กำเนิดบนใบหน้าและกะโหลกศีรษะในประเทศไทย

วัตถุประสงค์: เพื่อศึกษาการกระจายทางภูมิศาสตร์ในผู้ป่วยที่มีความพิการแต่กำเนิดบนใบหน้าและกะโหลกศีรษะ

วัสดุและวิธีการ: เป็นการศึกษาเชิงบรรยายแบบเก็บข้อมูลย้อนหลังโดยใช้ข้อมูลเวชระเบียนของผู้ป่วยที่มีความพิการแต่กำเนิดบนใบหน้าและกะโหลกศีรษะในโรงพยาบาลศรีนครินทร์ มหาวิทยาลัยขอนแก่น ปีงบประมาณ พ.ศ. 2548-2557 นำเสนอข้อมูลด้วยระบบภูมิสารสนเทศเพื่อแสดงการกระจายของที่อยู่ของผู้ป่วย

ผลการศึกษา: มีผู้ป่วยนอกทั้งหมด 4,721 คนซึ่งนอนพักรักษาในโรงพยาบาลจำนวน 2,922 คน เป็นชายร้อยละ 52.5 ส่วนใหญ่ (ร้อยละ 48.8) มีอายุระหว่าง 1-15 ปี พบว่ามีการกระจายมากที่สุดในจังหวัดขอนแก่นร้อยละ 23.8 โดยอาศัยในเขตเมืองคือตำบลในเมืองและตำบลที่ติดตัวเมือง ความชุกของโรคที่มากที่สุดคือภาวะปากแหว่งร่วมกับเพดานโหว่อ้อยละ 16.2 ส่วนภาวะที่พบมากที่สุดในขอนแก่นคือ ความพิการแต่กำเนิดของหนังตาและระบบน้ำตาและเบ้าตา

สรุป: ผู้ป่วยส่วนใหญ่อาศัยอยู่ในเขตเมืองโดยเฉพาะในตัวเมือง และมาจากจังหวัดขอนแก่นมากที่สุดคาดว่าสาเหตุ คือ การเข้าถึงบริการได้ง่ายกว่ารวมทั้งเป็นที่ตั้งศูนย์ และระบบการให้บริการด้านสุขภาพของรัฐ อย่างไรก็ตามระบบ ภูมิสารสนเทศจะถูกใช้ในการวางแผนการเข้าถึงการดูแลและการจัดสรรทรัพยากรทั้งหมดของผู้ป่วยกลุ่มนี้ซึ่งมีแนวโน้มสูงขึ้น
