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Population-based prevalence study of common congenital malformations of the alimentary tract and abdominal wall in Thailand: a study using data from the National Health Security Office

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ABSTRACT

Background The study aimed to estimate the prevalence of major congenital anomalies of the alimentary system and the abdominal wall in Thailand using a nationwide hospital discharge database from the National Health Security Office (2017–2020).

Methods The study extracted data from records with International Classification of Diseases-10 (ICD-10) codes related to esophageal malformation (ESO), congenital duodenal obstruction (CDO), jejunoileal atresia (INTES), Hirschsprung's disease (HSCR), anorectal malformation (ARM), abdominal wall defects (omphalocele (OMP) and gastroschisis (GAS)), and diaphragmatic hernia from the database with patient age selection set to less than 1 year.

Results A total of 2539 matched ICD-10 records were found in 2376 individuals over the 4-year study period. Concerning foregut anomalies, the prevalence of ESO was 0.88/10 000 births, while that of CDO was 0.54/10 000 births. The prevalence figures of INTES, HSCR, and ARM were 0.44, 4.69, and 2.57 cases per 10 000 births, respectively. For abdominal wall defects, the prevalences of OMP and GAS were 0.25 and 0.61 cases/10 000 births, respectively. The mortality in our cases was 7.1%, and survival analysis found that associated cardiac defects had a statistically significant influence on survival in most anomalies studied. In HSCR, both Down syndrome (DS) (hazard ratio (HR)=7.57, 95% confidence interval (CI)=4.12 to 13.91, p<0.001) and cardiac defects (HR=5.82, 95% CI=2.85 to 11.92, p<0.001) were significantly associated with poorer survival outcomes. However, only DS (adjusted HR=5.55, 95% CI=2.63 to 11.75, p<0.001) independently predicted worse outcomes by multivariable analysis.

Conclusions Our analysis of the hospital discharge database found that the prevalence of gastrointestinal anomalies in Thailand was lower than that reported in other countries, except for HSCR and anorectal malformations. Associated Down syndrome and cardiac defects influence the survival outcomes of these anomalies.

WHAT IS ALREADY KNOWN ON THIS TOPIC

Congenital anomalies involving the gastrointestinal tract and abdominal wall are among the pediatric surgical problems commonly encountered by pediatric surgeons worldwide. The prevalence figures of these anomalies differ among ethnic groups.

WHAT THIS STUDY ADDS

As there has been no previous report of the population-based prevalence of the anomaly group from Southeast Asia, the study evaluated the figure using large nationwide discharge data from a reimbursement program and analyzed disease-specific mortality rates.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

Apart from the prevalence figures, the study found an association among each anomaly and found that the mortality was higher when it was associated with congenital heart diseases or Down syndrome. This suggests that, to improve the outcomes of congenital gastrointestinal anomalies, taking care of the associated defects is also important.

INTRODUCTION

Congenital malformations of the gastrointestinal tract and the abdominal wall are birth defects that usually require immediate surgical management. Atresia and stenosis are relatively common anomalies that may occur in any part of the gastrointestinal tract from the esophagus and the duodenum to the rest of the small intestine.[1–3] Apart from alimentary tract anomalies, developmental defects involving the abdominal wall and diaphragm are among the common surgical conditions during the neonatal period.[4 5] The population-based prevalence of these congenital anomalies varies among geographical areas and periods of study.[6–8] Most of the reported prevalences of these diseases have been from studies in the Western world, which might not always represent the sizes of the same problem in other countries.

As an example of (ESO), a large population-based registry in European countries reported varying prevalences during 1987–2006, from 1.28/10 000 births to 4.55 births,[9] while a population-based registry in Nagano, Japan, reported a prevalence of 1.97/10 000 births.[10] The incidence of congenital duodenal obstruction (CDO) in the UK was estimated at 1.22 cases per 10 000 live births,[11] while another study from Japan reported a prevalence of 0.83.[10] An interesting disparity in reported prevalences was found in the case of gastroschisis (GAS), of which the prevalence reported in North America was around 3.4–4.18/10 000 births,[5 12] while the figure was 2.69 in Brazil[13] and 1.59 in Liaoning, China.[14] Population-based prevalences of these common pediatric surgical problems have never been reported from Southeast Asian countries, and the subject is worth exploring, as this type of epidemiological data can be meaningful in resource planning.

In Thailand, although there is no official registry for congenital anomalies nor rare diseases, reimbursement data from the National Health Security Office (NHSO) covered nearly all cases treated in the public sector. This study aimed to assess the number of neonatal cases diagnosed with congenital anomalies of the alimentary tract, abdominal wall defects and congenital diaphragmatic hernia (CDH) to estimate the prevalences of these anomalies in the Thai population. In addition, crude mortality rates were calculated for each group of anomalies.

MATERIALS & METHODS

Data source

The Thai Hospital Information Portal (THIP) is a cooperative data warehouse project managed jointly by the NHSO, the Institute of Research and Development for Health of Southern Thailand, and the National Science and Technology Development Agency. The project retrieved data from patient files submitted to NHSO for reimbursement. A 4-year collection, from 2017 to 2020, was completed and made available for analysis. In the records made available for analysis, the patient information, including personal identification (ID) numbers and hospital numbers, is hashed to anonymize the records. The variables available in the database included basic demographic data (age and sex), principal diagnosis, secondary diagnoses (up to 20 items), length of hospital stay, month and year of admission, discharge type, discharge category, treatment procedure(s), and health region where the patient was treated. Excluding the capital city (Bangkok), there are 12 health regions in Thailand. The subtracted data used in this study is available in the online supplemental file 1. A data dictionary for the databases is available online (https://thip.nbt.or.th/documents/data-dict.pdf).

For this study, data were retrieved from the THIP under the ICD-10 keys for anomalies of interest, namely, ESO (Q39.0, Q39.1, Q39.2, and Q39.3), CDO (Q41.0), jejunoileal atresia (INTES) (Q41.1, Q41.2, Q41.8, and Q41.9), Hirschsprung's disease (HSCR) (Q43.1), anorectal malformation (ARM) (Q42.0, Q42.1, Q42.2, Q42.3, Q42.8, and Q42.9), omphalocele (OMP) (Q79.2), GAS (Q79.3), and CDH (Q79.0). Only records of patients 1 year of age or younger were retrieved.

To analyze the associated Down syndrome (DS), the code Q90.9 was used, and the codes Q20.0–Q28.9 were used for congenital heart disease (CHD).

Data management

Analysis was performed with the Pandas package in the Python 3 programming language. Records with duplicated personal IDs were excluded. Data were then filtered for age of less than 1 year. After age filtration and elimination of duplications, the number of records was reduced from 6169 to 2376, each of which had at least one diagnostic key of interest.

The crude prevalence of each diagnostic group was calculated from the number of records with its corresponding ICD-10 key treated in each year divided by live birth statistics in that year, which was obtained from the Vital Statistics database from the National Statistical Office of Thailand (2017–2020). The numbers of live births in Thailand in 2017, 2018, 2019, and 2020 were 656 571, 628 450, 596 736, and 569 338, respectively. The Python code used in this study is available online (https://github.com/sasurasa/THIP/blob/main/Package201.1/SURPY/thip.py) or as a package 'thip' from the PyPi repository, with the module name 'SURPY' release V.1.4.15.

For survival analysis, because of the availability of data until the end of the fiscal year 2020, the last date of follow-up was then set as September 30, 2020. Survival analysis used Kaplan-Meier survival estimation, log-rank test, and Cox's proportional hazard model for comparison.

RESULTS

A total of 2539 matched ICD-10 codes of interest were found in 2376 individuals, divided into 741, 583, 530, and 522 records in 2017–2020, respectively. The diagnostic group with the highest number of patients was HSCR (4.69 per 10 000 live births), followed by ARM (2.57 per 10 000 live births) and ESO (0.88 per 10 000 live births). The crude prevalences of the various diagnostic groups are shown in table 1. The overall male-to-female ratio was 1.55, with the highest proportion in HSCR at 1.76 (table 2). The distribution of cases among the 13 health regions in Thailand is shown in online supplemental figure S1. Note that although the number of study-relevant births in Bangkok during the 4-year analysis was 12.5% of the whole country, 23.6% of all cases were treated in the Bangkok region, followed by health region 12 (10.7%), which covers the southernmost part of the country.

There were 216 records that matched the ESO group; 88 were recorded as Q391 (esophageal atresia without

Table 1 Case number and crude incidence per 10 000 live births of major gastrointestinal anomalies in Thailand

Anomaly group	Number of cases in the year *				Average number of case per year*
	2017	2018	2019	2020	
ESO	60 (0.91)	48 (0.76)	50 (0.83)	58 (1.02)	54.00 (0.88)
CDO	34 (0.52)	38 (0.60)	20 (0.34)	41 (0.72)	33.25 (0.54)
INTES	28 (0.43)	27 (0.43)	26 (0.44)	27 (0.47)	27.00 (0.44)
HSCR	366 (5.57)	301 (4.79)	258 (2.86)	233 (2.93)	289.50 (4.69)
ARM	194 (2.95)	151 (2.40)	144 (2.41)	142 (2.49)	157.75 (2.57)
OMP	30 (0.45)	10 (0.16)	13 (0.22)	10 (0.18)	15.75 (0.25)
GAS	41 (0.62)	33 (0.53)	31 (0.52)	43 (0.76)	37.00 (0.61)
CDH	14 (0.21)	21 (0.33)	28 (0.47)	19 (0.33)	20.50 (0.34)

*In parentheses: crude prevalence per 10 000 live births.
ARM, anorectal malformation; CDH, congenital diaphragmatic hernia; CDO, congenital duodenal obstruction; ESO, esophageal malformation; GAS, gastroschisis; HSCR, Hirschsprung's disease; INTES, jejunoileal atresia; OMP, omphalocele.

fistula); 139 were Q392 (esophageal atresia with tracheo-esophageal fistula); and 78 were the remaining types. CDO had 133 matched records, while 108 cases matched the code for atresia/stenosis of other small intestinal parts. Associated DS was found in 45.9% of the duodenal atresia/stenosis cases and 4.6% in cases of atresia/stenosis of other small intestinal parts.

HSCR (Q43.1) had the highest incidence among the anomalies in this study. The incidence rate of DS in HSCR was 5.1%, while the associated cardiac anomaly rate was 3.7%. Considering records of primary procedure of the individual patients, 94 cases had an International Classification of Diseases-9 (ICD-9) record of procedure codes related to a temporary ostomy (codes 4610, 4611, 4620, 4621, and 4652); 204 cases had the record of '4841: Soave submucosal resection of rectum', 104 cases with '4849: other pull-through resection of rectum', 42 cases with '4865: Duhamel resection of rectum', and 30 cases with '4824: biopsy of rectum'

During the 4 years, there were 631 records that matched the set of ARM-related codes, which included 76 cases of Q42.0: congenital absence, atresia, and stenosis of the rectum with fistula; 35 cases of Q42.1: congenital absence, atresia, and stenosis of the rectum without fistula; 184 cases of Q42.2: congenital absence, atresia, and stenosis of the anus with fistula; 413 cases of Q42.3: congenital absence, atresia, and stenosis of anus without fistula; 13 cases of Q42.8: congenital absence, atresia, and stenosis of other parts of the large intestine; and 34 cases of Q42.9: congenital absence, atresia, and stenosis of the large intestine, part unspecified.

On analysis of inter-relations among the eight anomalies studied, high coincidences were found between esophageal atresia and ARM (10.65%) and between GAS

Table 2 Demographic data of the records in each group of anomaly including sex ratio, associated Down syndrome and cardiac anomaly, and crude mortality

Anomaly group	n*	Sex ratio (M:F)	Down syndrome (%)	Cardiac anomaly (%)	Overall mortality (%)	Length of stay (days)†
ESO	216	1.37	3.24	30.09	14.35	10.87
CDO	133	0.84	45.86	30.08	10.53	17.35
INTES	108	1.08	4.63	5.56	8.33	28.79
HSCR	1158	1.76	5.09	3.71	4.75	9.85
ARM	631	1.60	13.15	18.54	7.45	10.30
OMP	63	1.42	1.59	14.29	11.11	6.73
GAS	148	1.64	0.68	1.35	9.46	9.17
CDH	82	1.56	2.44	18.29	8.54	10.82
Overall	2376	1.55	8.71	11.11	7.28	8.00

*Total number in 4 years.
†Length of stay (first admission) was analyzed only in patients who were discharged alive 'with approval'.
ARM, anorectal malformation; CDH, congenital diaphragmatic hernia; CDO, congenital duodenal obstruction; ESO, esophageal malformation; F, female; GAS, gastroschisis; HSCR, Hirschsprung's disease; INTES, jejunoileal atresia; M, male; OMP, omphalocele.

Table 3 Association among the studied anomalies

	Primary anomaly							
Associated anomaly	ESO	CDO	INTES	HSCR	ARM	OMP	GAS	CDH
ESO		7.52%	0.00%	0.09%	3.96%	0.00%	0.00%	0.00%
CDO	3.24%		0.00%	0.14%	0.95%	0.00%	0.00%	1.22%
INTES	0.00%	0.75%		0.43%	0.48%	1.59%	5.41%	0.00%
HSCR	0.46%	2.26%	3.70%		2.22%	0.00%	0.68%	0.00%
ARM	10.65%	4.51%	1.85%	0.86%		1.59%	4.05%	1.22%
OMP	0.00%	0.00%	0.93%	0.00%	0.16%		0.00%	1.22%
GAS	0.00%	0.75%	6.48%	0.17%	1.11%	0.00%		0.00%
CDH	0.00%	0.75%	0.00%	0.00%	0.16%	1.59%	0.00%	

ARM, anorectal malformation; CDH, congenital diaphragmatic hernia; CDO, congenital duodenal obstruction; ESO, esophageal malformation; GAS, gastroschisis; HSCR, Hirschsprung's disease; INTES, jejunoileal atresia; OMP, omphalocele.

and intestinal atresia (6.48%) (table 3). Interestingly, the study found a high incidence of ESO (7.25%) recorded in cases of duodenal atresia (table 3) and a relatively high incidence of HSCR in cases of INTES (3.70%). On Kaplan-Meier survival analysis, the survival probability at 1 year after the first admission was 93.52% (95% CI=92.42% to 94.44%) and the survival probability at 4 years was 91.85% (95% CI=90.54% to 92.99%). Patients with associated CHD had significantly poorer survival than those without CHD (online supplemental figure S2 B). In the mortality cases, half of all deaths occurred within 83 days after the first treatment, and 75% occurred within 237 days. The average length of hospital stay at the first admission was 12.1 days.

When analyzing the presence of Down syndrome and the presence of CHD with survival, both factors were risks of mortality at hazard ratios (HRs) of 2.54 (95% confidence interval (CI)=1.72 to 3.76) and 4.93 (95% CI=3.60 to 6.76), respectively (table 4 and online supplemental figure S2A,B). However, by multivariable Cox regression, DS was found to be a covariate of CHD in survival outcomes with adjusted HRs of 1.34 (95% CI=0.87 to 2.04) and 4.52 (95% CI=3.21 to 6.37), respectively. On univariate analysis performed in each anomaly group, DS had a significant association with the mortality status of patients with HSCR (p<0.001) and CDH (p=0.006), while CHD had significant associations with death in ESO (p=0.004), CDO (p=0.004), HSCR (p<0.001), ARM (p<0.001), OMP (p=0.026), and CDH (p<0.001) (table 4). Interestingly, in cases of HSCR, DS (adjusted hazard ratio (HR) 5.55, 95% CI=2.63 to 11.75) was found to outperform congenital cardiac anomalies (adjusted HR 2.11, 95% CI=0.88 to 5.10) in survival function (online supplemental figure S2C,D), while both factors had an independent association with survival in CDH (adjusted HR 19.90, 95% CI=1.66 to 239.23) for DS and 13.65 (95% CI=2.75 to 87.08) in cardiac anomalies.

DISCUSSION

Recent progress in surgery and perioperative support has tremendously reduced mortality from surgical conditions in newborn patients, especially in high-resource countries.[15–17] In Japan and the USA, overall mortality in surgical newborns has been reduced to less than 10% in previous decades.[15 16] One of the key success factors in surgical quality improvement in these countries was the establishment of a national case-registry program that drove gradual but sustainable changes in treatment outcomes. In some situations, with limitations of neonatal surgical facilities, a number of cases are transferred to receive surgical care in other centers, and hospital-based case series might not reflect the picture of the whole country. In Thailand, such a registry for surgical neonates has not been established. However, as nearly all neonatal surgical patients are taken care of in a provincial referral center or a university hospital and the reimbursement of hospital expenses is submitted to the universal health coverage (UHC) program managed by the NHSO, mining of the discharge summary data can provide a crude picture of disease prevalence that can be used in health policy planning.[18] Currently, the only data available through the NHSO are from the fiscal years 2017–2020.

According to our analysis of the 4 years of NHSO data, the number of neonates with common surgical conditions in Thailand ranged from 550 to 750 cases per year or around 9.5–11.5 cases per 10 000 births, with no significant trend of change over the period. Our prevalence of ESO at 0.9/10 000 births was much lower than those reported in Europe (1987–2006) at 2.43/10 000 births[9] or in Japan (1993–2011) at 1.97/10 000 births,[10] which might be explained by under-recording or miscoding. Lower-than-expected prevalence figures were also found in other anomalies in our study, except for HSCR (4.69/10 000 births) and ARM (2.54/10 000 births).[19 20] We can explain

Table 4 Survival analysis considering Down syndrome and congenital heart disease as risk factors in each group of anomaly

			P value*			P value
Disease group	Survival at 1 year		HR (95% CI)	Survival at 1 year		HR (95% CI)
ESO	Without DS	86.56%	0.941	Without CHD	90.15%	0.004
	With DS	85.71%	0.93 (0.12 to 6.81)	With CHD	78.32%	2.72 (1.34 to 5.52)
CDO	Without DS	94.25%	0.122	Without CHD	94.32%	0.004
	With DS	85.10%	2.31 (0.77 to 6.92)	With CHD	80.48%	4.42 (1.48 to 13.19)
INTES	Without DS	92.64%	0.245	Without CHD	92.61%	0.299
	With DS	80.00%	3.23 (0.40 to 26.31)	With CHD	83.33%	2.89 (0.35 to 23.49)
HSCR	Without DS	97.01%	<0.001	Without CHD	96.67%	<0.001
	With DS	74.47%	7.57 (4.12 to 13.91)	With CHD	75.78%	5.82 (2.85 to 11.92)
			5.55 (2.63 to 11.75)†			2.11 (0.88 to 5.10)†
ARM	Without DS	93.27%	0.595	Without CHD	95.68%	<0.001
	With DS	92.19%	1.24 (0.56 to 2.78)	With CHD	81.89%	4.57 (2.55 to 8.21)
OMP	Without DS	90.29%	0.726	Without CHD	92.56%	0.026
	With DS	100.00%	NA	With CHD	77.78%	4.68 (1.05 to 20.93)
GAS	Without DS	93.44%	NA	Without CHD	92.43%	0.612
	With DS	NA	NA	With CHD	100.00%	NA
CDH	Without DS	91.92%	0.006	Without CHD	96.66%	<0.001
	With DS	50.00%	10.83 (1.29 to 90.64)	With CHD	66.67%	12.97 (2.51 to 66.98)
			19.90 (1.66 to 239.23)†			15.49 (2.75 to 87.08)†
Overall	Without DS	94.31%	<0.001	Without CHD	95.32%	<0.001
	With DS	84.92%	2.54 (1.72 to 3.76)	With CHD	78.80%	4.93 (3.60 to 6.76)
			1.34 (0.87 to 2.04)†			4.53 (3.21 to 6.37)†

*P value of log-rank test.
†Adjusted HR.
ARM, anorectal malformation; CDH, congenital diaphragmatic hernia; CDO, congenital duodenal obstruction; CHD, congenital heart disease; CI, confidence interval; DS, Down syndrome; ESO, esophageal malformation; GAS, gastroschisis; HR, hazard ratio; HSCR, Hirschsprung's disease; INTES, jejunoileal atresia; NA, not analyzed; OMP, omphalocele.

the high prevalence of HSCR in the first year of the study by its requirement for multiple admissions, and patients born in the prior year would also be counted when they were admitted in the study period. This phenomenon occurred in a German study of ARM, in which they compared diagnostic-related groups and the ICD-10.[6] A study from Australia found that when comparing hospital discharge data with a registered cohort, coverage accuracy varied among the types of anomalies. In that study, while abdominal wall defects had nearly complete concordance in coding, digestive system anomalies had an approximately 93% concordance rate, and there was a tendency of hospital records to overcount these anomalies.[21] Comparing the number of abdominal wall defects with other registry-based reports,[22–24] our number of cases was estimated to capture approximately 60%–80% of the true prevalence. As of 2021, the number of certified pediatric surgeons registered with the Thai Medical Council was 214.[25] Based on the prevalence figures, each surgeon would have an opportunity to take care of fewer than five new cases of surgical neonates with major gastrointestinal anomalies per year, which indicates that neonatal surgical care in Thailand should be centralized to regional centers rather than disseminating to every general hospital, considering the fact that the case volume is essential for maintaining technical skills.

Our general mortality rate at 7.1% was comparable with other reports, and it was not surprising that relatively high mortality was found in ESO, CDO, and OMP. The mortality of diaphragmatic hernia in our study (8.5%) was relatively lower than those reported in the literature (10%–30%).[26] A possible explanation was that our study did not include stillbirths and neonatal deaths at the local hospital before referral, without accurate diagnostic codes. The study also found that associated cardiac anomalies were the main factors associated with poorer survival outcomes in these birth defects and some other anomalies, including HSCR, ARM, and CDH. Overall, cardiac defects had a greater negative association with survival than DS, with the exception of HSCR. The strong association between DS and

mortality in Hirschsprung disease might be explained by a higher incidence of enterocolitis and poorer continence in Hirschsprung's patients with DS.[27] The evidence emphasizes the significance of concomitant management of associated anomalies in a neonate with congenital anomalies involving the gastrointestinal tract, which might hamper a good outcome. Analyzing associations among groups of anomalies was also feasible with our derived data. Apart from a Vertebral anomalies, Anorectal malformations, Cardiac defects, TrecheoEsophageal anomalies, Renal anomalies, and Limb anomalies (VACTERL) association that was expected, associations between esophageal atresia and CDO and between INTES and GAS were also found.

The notable strength of our study was that the data were taken from a nationwide public reimbursement program (UHC) that covers at least 72% of the healthcare services in the country. Additionally, the data were not affected by referral status, and mortality data were not distorted by publication bias from institutes with better academic resources. However, as data from the UHC program are not a predefined registration program, the accuracy of recorded diagnosis was a limitation of our study. Induced abortion by fetal indications was not legal in Thailand until 2021, and the practice might be performed in cases of fetal anomalies under maternal health concerns. Although an exact figure of pregnancy termination after a prenatal diagnosis of congenital anomalies was not known, a survey by the Ministry of Public Health in 2004 reported an estimated induced abortion ratio of 19.5 per 1000 live births, which influences the prevalence of some congenital anomalies.[28 29] The lower induced abortion rate in region 12, in which Muslim Thai predominates, might explain the higher prevalence of certain congenital anomalies in this region.

In conclusion, the study analyzed a nationwide database for the prevalence of common congenital gastrointestinal and abdominal wall anomalies. Although the study found lower-than-expected prevalences when compared with population-based registries from other countries, the mortality figures were comparable and were significantly affected by the presence of associated cardiac defects.

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Contributors KSi: acquisition and analysis of data and drafting of the manuscript; WL: acquisition, analysis, and interpretation of data; KSu: acquisition, analysis and interpretation of data; SS: data analysis, program coding, manuscript editing and final approval of the version to be published. SS is also the guarantor.

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Patient consent for publication Not applicable.

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REFERENCES

1 Berrocal T, Lamas M, Gutieérrez J, *et al*. Congenital anomalies of the small intestine, colon, and rectum. *Radiographics* 1999;19:1219–36.
2 Berrocal T, Torres I, Gutiérrez J, *et al*. Congenital anomalies of the upper gastrointestinal tract. *Radiographics* 1999;19:855–72.
3 Choi G, Je BK, Kim YJ. Gastrointestinal emergency in neonates and infants: a pictorial essay. *Korean J Radiol* 2022;23:124.
4 Boulet SL, Correa-Villaseñor A, Hsia J, *et al*. Feasibility of using the National hospital discharge survey to estimate the prevalence of selected birth defects. *Birth Defects Res A Clin Mol Teratol* 2006;76:757–61.
5 Liu S, Evans J, Boutin A, *et al*. Time trends, geographic variation and risk factors for gastroschisis in Canada: a population-based cohort study 2006-2017. *Paediatr Perinat Epidemiol* 2021;35:664–73.
6 Jenetzky E. Prevalence estimation of anorectal malformations using German diagnosis related groups system. *Pediatr Surg Int* 2007;23:1161–5.
7 Bower CI, Lester-Smith D, Elliott EJ. Congenital anomalies -- why bother? *Med J Aust* 2010;192:300–1.
8 Santoro M, Coi A, Pierini A, *et al*. Temporal and geographical variations in survival of children born with congenital anomalies in Europe: a multi-registry cohort study. *Paediatr Perinat Epidemiol* 2022;36:792–803.
9 Pedersen RN, Calzolari E, Husby S, *et al*. Oesophageal atresia: prevalence, prenatal diagnosis and associated anomalies in 23 European regions. *Arch Dis Child* 2012;97:227–32.
10 Takahashi D, Hiroma T, Takamizawa S, *et al*. Population-Based study of esophageal and small intestinal atresia/stenosis. *Pediatr Int* 2014;56:838–44.
11 Bethell GS, Long A-M, Knight M, *et al*. Congenital duodenal obstruction in the UK: a population-based study. *Arch Dis Child Fetal Neonatal Ed* 2020;105:178–83.
12 Benjamin BG, Ethen MK, Van Hook CL, *et al*. Gastroschisis prevalence in Texas 1999-2003. *Birth Defects Res A Clin Mol Teratol* 2010;88:178–85.
13 Calderon MG, Santos EF de S, Abreu LC de, *et al*. Increasing prevalence, time trend and seasonality of gastroschisis in São Paulo state, Brazil, 2005–2016. *Sci Rep* 2005;9.
14 Li N, Chen Y-L, Li J, *et al*. Decreasing prevalence and time trend of gastroschisis in 14 cities of Liaoning Province: 2006–2015. *Sci Rep* 2016;6:33333.
15 Yagi M, Kohno M, Asagiri K, *et al*. Twenty-Year trends in neonatal surgery based on a nationwide Japanese surveillance program. *Pediatr Surg Int* 2015;31:955–62.
16 Bucher BT, Duggan EM, Grubb PH, *et al*. Does the American College of surgeons national surgical quality improvement program pediatric provide actionable quality improvement data for surgical neonates? *Journal of Pediatric Surgery* 2016;51:1440–4.
17 Puri A, Lal B, Nangia S. A pilot study on neonatal surgical mortality: a multivariable analysis of predictors of mortality in a resource-limited setting. *J Indian Assoc Pediatr Surg* 2019;24:36.

18 Sumriddetchkajorn K, Shimazaki K, Ono T, *et al*. Universal health coverage and primary care, Thailand. *Bull World Health Organ* 2019;97:415–22.
19 Suita S, Taguchi T, Ieiri S, *et al*. Hirschsprung's disease in Japan: analysis of 3852 patients based on a nationwide survey in 30 years. *Journal of Pediatric Surgery* 2005;40:197–202.
20 Chia S-T, Chen S-C, Lu C-L, *et al*. Epidemiology of Hirschsprung's disease in Taiwanese children: a 13-year nationwide population-based study. *Pediatr Neonatol* 2016;57:201–6.
21 Schneuer FJ, Lain SJ, Bell JC, *et al*. The accuracy of hospital discharge data in recording major congenital anomalies in Australia. *Birth Defects Res* 2021;113:1313–23.
22 Suita S, Okamatsu T, Yamamoto T, *et al*. Changing profile of abdominal wall defects in Japan: results of a national survey. *Journal of Pediatric Surgery* 2000;35:66–72.
23 Tan KB, Tan KH, Chew SK, *et al*. Gastroschisis and omphalocele in Singapore: a ten-year series from 1993 to 2002. *Singapore Med J* 2008;49:31–6.
24 Caldeman C, Fogelström A, Oddsberg J, *et al*. National birth prevalence, associated anomalies and mortality for gastroschisis in Sweden. *Acta Paediatr* 2021;110:2635–40.
25 Statistics of medical professions in Thailand. 2022. Available: https://www.tmc.or.th/pdf/stat-med-15-08-22-004.pdf [Accessed 31 Oct 2022].
26 Dingeldein M. Congenital diaphragmatic hernia: management & outcomes. *Adv Pediatr* 2018;65:241–7.
27 Friedmacher F, Puri P. Hirschsprung's disease associated with Down syndrome: a meta-analysis of incidence, functional outcomes and mortality. *Pediatr Surg Int* 2013;29:937–46.
28 Warakamin S, Boonthai N, Tangcharoensathien V. Induced abortion in Thailand: current situation in public hospitals and legal perspectives. *Reprod Health Matters* 2004;12(24 Suppl):147–56.
29 Chaturachinda K, Boonthai N. A commentary on the recent ruling by the Thai constitutional court in relation to abortion law in Thailand. *Sex Reprod Health Matters* 2020;28:1776542.