RESEARCH REPORTS

Birth Defect Surveillance in the Main Government Referral Hospital of Maldives from 2016 to 2024

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ABSTRACT *We studied birth defects in the main tertiary government hospital, Indira Gandhi Memorial Hospital (IGMH) of Maldives from 2016 to 2024. All inborn live births in the 9-year period were included. Still births and miscarriages were excluded. ICD 10 was used for coding. There were 17188 live births, and 729 babies (4.24%) had birth defects described under Q code of ICD-10. A total of 1215 defects were noted. The number of females was 313 (43%) and there were 16 from twin deliveries. 312 defects (26% of all defects) were in preterm babies. Out of 710 mothers who delivered babies with birth defects, 107 (15%) had gestational diabetes. Median birth weight was 2,862 gm (range from 630gm to 5,000gm), and median gestational age was 37.5 weeks (range from 25 to 41 weeks) for neonates with birth defects. Looking at neonatal outcomes, 24 had hypoglycaemia (3.3%), 21 had hypothermia (2.9%), 27 babies died before discharge (3.7%). The most common cause for neonatal deaths with birth defects was lung hypoplasia (total 6 patients, 22% of deaths). Two deaths were due to diaphragmatic hernia and another 2 had Potter's syndrome. 82 (11.2%) babies required bag and mask ventilation. The overall incidence of total birth defects in our study was 42.4 per 1000 live births. This includes significant and non-significant birth defects under the ICD code Q. The most common were congenital malformations of the circulatory system, which consists of 28.7% of defects with an incidence of 20 per 1000 live births. Birth defects were common in our study. Respiratory system defects were the cause for highest mortality.*

Keywords: Birth Defects, Maldives, Surveillance

Introduction

Birth defects, which are structural and functional anomalies that are of prenatal origin, have been acknowledged as a significant global and public health concern. These defects may be identified antenatally, at birth, or later in life. The Sixty-third World Health Assembly in May 2010 recognized birth defects as a major global public health challenge and a significant contributor to child mortality (including stillbirths and neonatal deaths). As such, resolution WHA63.17, called upon member states to strengthen birth defect surveillance, prevention, and treatment efforts (World Health Assembly, 2010). Furthermore, addressing birth defects was an important pillar for achieving Millennium Development Goal 4: Reduce Child Mortality (United Nations, 2016). This matter was further reiterated during the seventy-seventh World Health Assembly in 2024 due to concerns that an alarming number of countries will be unable to meet the neonatal and under-five mortality rate targets set by the 2016 United Nations Sustainable Development Goal 3.2 (United Nations, 2024; World Health Assembly, 2024).

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Birth defects are not a rare occurrence. According to the March of Dimes global report in 2006, around 7.9 million children (6% of total births worldwide) were born with a serious birth defect every year (Christianson, Howson & Modell, 2006). Furthermore, the World Health Organization (WHO) estimates that birth defects were responsible for 6.7% of annual neonatal deaths worldwide (World Health Organization, 2008). March of Dimes further noted that over 90% of these cases were from low to middle income countries (Christianson et al., 2006). In the South-East Asian region, birth defects contribute to around 7% of under-five mortality cases, which is similar to the global average. However, in high income countries, it can go up to 30-35% due to a reduction in child mortality due to other causes such as birth asphyxia, prematurity, and infectious diseases (World Health Organization, Regional Office for South-East Asia, 2016; World Health Organization, 2012).

While these figures reflect global and regional burden, country-specific data, especially for small island nations like the Maldives, remained scarce. A study done in one general hospital of Srilanka showed incidence of birth defects as 2.6% (Perera, Gamhewage & Weerasekera, 2019). Another study, which was done by the Ministry of Public Health in Thailand, showed birth defect incidence of 2% in their population (Kuptanon et al., 2025). In the Maldives, incidence of birth defects was reported as 11.9 - 20 per 1000 live births (around 1-2%) from 2014 to 2018; however, this was only assessed based on intramural births in Indira Gandhi Memorial Hospital (IGMH) during that period (Health Protection Agency, 2014). The under-five mortality due to birth defects in Maldives was estimated to be around 30% in 2010 (World Health Organization, 2012). However, this estimate was prior to the establishment of a national surveillance program.

As there was limited data from member countries, the WHO Regional Office for South-East Asia (SEARO) established an electronic data system (Southeast Asia Region Newborn Birth Defects [SEAR-NBBD]) in 2014 to collect standardized data on new-borns and birth defects. Subsequently, the Maldives, as a member state of SEARO, became a partner in this surveillance network. The responsibility of collection and analysis of the data was entrusted to the participating centre.

Birth defect surveillance is the systematic collection, analysis, and interpretation of defects present at birth. Existing research recognizes the critical role played by surveillance studies in the timely detection, prevention, and management of birth defects. Birth defects associated with thalidomide and Zika virus have taught us that surveillance data creates great opportunities for alarming the world about the teratogenic effects of pathogens (Larrandaburu et al., 2017) and chemicals (Lenz, 1966). A similar surveillance study was done for rubella virus-induced congenital rubella syndrome and showed the importance of enhanced surveillance in timely reporting and response to outbreaks of the disease and efficacy of preventative measures (Khanal et al., 2024). Surveillance of birth defects and study of risk factors in expectant mothers found important teratogenic effects of drugs like antiepileptics (Tomson & Battino, 2012).

The primary objective of this study was to ascertain the incidence, phenotypic distribution, and temporal trends of congenital anomalies among live births in IGMH, Maldives, over a nine-year surveillance period from January 2016 to

December 2024. The dataset offers critical epidemiological insights into the prevalence and patterns of birth defects within the Maldivian population. These findings serve as a foundational resource for informing clinical decision-making, guiding evidence-based public health interventions, and shaping national policy frameworks aimed at mitigating the burden of congenital disorders. By elucidating temporal trends and diagnostic distributions, the study contributes to regional benchmarking and supports strategic planning for maternal and child health programs.

Methodology

Maldives became a partner in the online WHO South-East Asia Region Newborn Birth Defects (SEAR-NBBD) registry in November 2015. It was a passive, hospital-based birth defect surveillance that includes all inborn live births from January 2016 to December 2024.

All the inborn neonates were examined for birth defects at birth, once daily before discharge and during follow up visits. In addition, necessary radiological examinations were carried out for diagnosis of birth defects. Stillbirths and miscarriages were excluded.

The case definition and initial descriptions were done by verbatim description of the birth defect(s). Photographs of defects and radiological reports were uploaded online. The reports and descriptions were verified by experts at local and regional level. Birth defects that were listed in Chapter XVII, (Q00-Q99) of 10th International Classification of Diseases modified by the Royal College of Paediatrics and Child Health adaptation ICD-10 named as Congenital malformations, deformations and chromosomal abnormalities were included. Defects such as thalassemia and G6PD deficiency that were not under Q code were excluded.

This is a hospital-based study done in IGMH, Maldives. IGMH is the main government referral hospital where all services were covered under state insurance. In the 9 years of study, 32.4% of deliveries in Maldives were carried out at IGMH.

All neonates less than 28 days, who had any birth defect under Q code of ICD 10 whether small or large were included. Reporting was done for those who were diagnosed before discharge, during follow up, and those who have undergone echocardiography and other investigations within 28 days of life. All defects were confirmed and reported postnatally.

Once a birth defect was detected, a form was filled which was later entered into the online SEAR-NBBD database. Every newborn was registered in the hospital system and a unique registration number was assigned. This registration number was used for data entry and it was a prerequisite for entry of further data. Verbal consent was taken from parents before taking photographs. Detailed description of the defects was documented along with the attached photographs. Once it was entered into the database, experts in the WHO SEAR office verified whether the code, diagnosis, and photographs matched. Forms were returned for correction if required, and later resubmitted for second verification.

Results

During the study period from 2016 to 2024, a total of 17,188 live births were

recorded at IGMH. Among these, 729 infants (4.2%) were born with birth defects classified under the Q codes of the ICD-10 system. In total, 1,215 birth defects were documented. The overall incidence of birth defects was 42.4 per 1000 live births, which included both significant and non-significant anomalies. Table 1 shows the demographic profile for the neonates with birth defects.

Among the 729 infants with birth defects, 708 were singletons, 16 were from twin pregnancies, and in five cases, the plurality was not documented. Regarding the mode of delivery, 301 infants (41.3%) were delivered vaginally, 360 (49.4%) via emergency cesarean section, and 68 (9.3%) through elective cesarean section. Of the 710 mothers who delivered infants with birth defects, 107 (15%) had gestational diabetes. Maternal age ranged from 16 to 43 years, while paternal age ranged from 19 to 65 years.

Among the neonates with birth defects, 312 (25.7%) birth defects were noted in preterm babies, 899 (74%) in term babies, and gestational age was not documented in four of the babies with birth defects. The median gestational age was 37.5 weeks. Birth defects were more commonly observed in male infants, accounting for 415 (56.9%) cases, compared to 313 (42.9%) cases in females. One infant was documented as born with ambiguous genitalia. The median birth weight of affected infants was 2,862 grams (range: 630–5,000g). A total of 82 infants (11.2%) required resuscitation beyond the initial steps.

Regarding neonatal outcomes in babies with birth defects, 24 (3.3%) experienced hypoglycemia, 21 (2.9%) had hypothermia, and 27 (3.7%) died before hospital discharge. The leading cause of neonatal death among infants with birth defects was Pulmonary Hypoplasia (6 out of 27 cases, equivalent to 22%). Notably, two of these cases had Congenital Diaphragmatic Hernia, while two others had Potter's syndrome.

Table 1. Demographic profile for neonates with birth defects

	Number of Cases	**Percentage of Cases**
Total number of defects	1215	-
Gestational Age		
Defects in Preterm	312	25.7
Defects in Term	899	74.0
Defects in babies with Undocumented Gestation	4	<1
Total number of neonates with defects	729	-
Gender		
Male	415	56.9
Female	313	42.9
Ambiguous	1	<1

Multiple Pregnancy		
Singleton	708	97.1
Twin	16	2.2
Undocumented	5	<1
Mode of Delivery		
Vaginal delivery	301	41.3
Elective cesarean section	68	9.3
Emergency cesarean section	360	49.4
Neonatal Outcome		
Resuscitation beyond initial steps	82	11.2
Hypoglycemia	24	3.3
Hypothermia	21	2.9
Death prior to hospital discharge	27	3.7

Table 2 summarizes the birth defects noted per system. The most frequently observed anomalies were congenital malformations of the circulatory system, accounting for 344 defects, with an incidence of 20 per 1,000 live births. It was followed by anomalies in the musculoskeletal system and digestive system.

Table 2. Number of birth defects according to systems involved

System involved	**Number of Defects**	**% out of total defects**	**Incidence per 1000 live births**
Circulatory system	344	28.7	20.0
Musculoskeletal system	190	15.8	11.1
Digestive system	153	12.8	8.9
Genital organs	116	9.7	6.7
Eye, ear, face and neck	110	9.2	6.4
Others	102	8.5	5.9
Nervous system	51	4.3	3.0
Urinary system	48	4.0	2.8
Chromosomal abnormalities	48	4.0	2.8
Cleft lip and palate	27	2.3	1.6
Respiratory system	10	0.8	0.6

Table 3 illustrates the incidence of the most common and significant defects. Acyanotic Congenital Heart Defects remained the most common group of isolated

cardiac anomalies. Among these, Atrial Septal Defect (ASD) was most frequently isolated (110 babies), Patent Ductus Arteriosus (PDA) was documented in 86 babies, and Ventricular Septal Defect (VSD) was seen in 61 babies with cardiac defects. Talipes Equinovarus was the most common deformity noted from the musculoskeletal system. Among defects noted in the digestive system, Ankyloglossia was the most frequent defect. Trisomy 21 was the most frequently detected chromosomal anomaly. There were 2 cases of Patau Syndrome and 1 case of Edward Syndrome diagnosed during the studied period.

Table 3. Incidence of most common and significant defects

System	Type of defect	Total	Incidence /10000live birth
Q00-Q07 Congenital malformations of the nervous system	Q02 Microcephaly	10	6
	Q03-Q03.9 Congenital hydrocephalus	10	5.8
	Q05.2- Q05.8 Spina bifida with hydrocephalus	8	4.7
Q10-Q18 Congenital malformations of eye, ear, face and neck	Q12.0 Congenital cataract	3	1.7
	Q17.0 Accessory auricular tag	42	24.4
	Q17.4 Low set ear	20	11.6
Q20-Q28 Congenital malformations of the circulatory system	Q20.0-Q20.5 Abnormalities of ventricular outlets	16	9.3
	Q21.0 Ventricular septal defect	61	35.5
	Q21.1 Atrial septal defect	36	20.9
	Q21.10 Ostium secundum atrial septal defect (type lI)	74	43.1
	Q21.11 Patent or persistent foramen ovale	15	8.7
	Q21.3 Tetralogy of Fallot	9	5.2
	Q22.0-Q22.1 Pulmonary valve atresia, stenosis	11	6.4
	Q22.5 Ebstein's anomaly	2	1.2
	Q22.6 Hypoplastic right heart syndrome	1	0.6
	Q24.0 Dextrocardia	5	2.9
	Q25.0 Patent ductus arteriosus	86	50
	Q25.1 Coarctation of aorta	5	2.9
	Q26.2-Q26.21 Total anomalous pulmonary venous connection	7	4.1

Q30-Q34 Congenital malformations of the respiratory system	Q30.0 Choanal atresia	3	1.7
	Q31.40 Congenital laryngomalacia	1	0.6
	Q33.6 Hypoplasia and dysplasia of lung	6	3.5
Q35-Q37 Cleft lip and palate	Q35.0-Q35.61 Clefts in palate	11	6.4
	Q36.9 Clefts in lip	2	1.2
	Q37.0-Q37.50 Cleft in palate and lip	12	7.0
Q38-Q45 Other congenital malformations of the digestive system	Q38.1 Ankyloglossia	113	65.7
	Q39.1 Atresia of esophagus with tracheo-oesophageal fistula	7	4.1
	Q41.0 Congenital absence, atresia and stenosis of duodenum, ileum	4	2.3
	Q42.0-Q42.3 Congenital absence, atresia and stenosis of rectum with fistula	13	7.6
Q50-Q56 Congenital malformations of genital organs	Q52.6 Congenital malformation of clitoris	8	4.7
	Q53-Q53.9 Undescended testicle	61	35.5
	Q54.0-Q54.3 Hypospadias.	23	13.4
Q60-Q64 Congenital malformations of the urinary system	Q60 Renal genesis and other reduction defects of kidney	6	3.5
	Q60.6 Potter's syndrome	3	1.7
	Q62.0 Congenital hydronephrosis	18	10.5
	Q62.10 -Q62.11 Congenital pelviureteric junction obstruction	3	1.7
Q65-Q79 Congenital malformations and deformations of the musculoskeletal system	Q66.0 Talipes equinovarus	76	44.2
	Q66.1 Talipes calcaneovarus	6	3.5
	Q69.0- Q69.2 Accessory fingers), toe(s)	34	19.8
090-Q99 Chromosomal abnormalities	Q90 Down's syndrome	43	25.0

Discussion

Birth defect surveillance data remains limited across low and middle-income countries (Christianson et al., 2006). Publicly available, country-specific data from the Maldives are particularly scarce. This study represents the most extensive hospital-based survey of birth defects conducted in the Maldives to date. The South-East Asia Regional Newborn and Birth Defects (SEAR-NBBD) surveillance

system employs passive data collection from healthcare facilities across the countries in the region, supported by a structured hierarchy of quality assurance mechanisms to enhance data reliability.

Robust surveillance data are essential for informing the development and implementation of effective prevention and management strategies for congenital anomalies. In the Maldives, termination of pregnancy is legally permitted only for select congenital conditions, such as Beta Thalassemia Major and anomalies deemed incompatible with life. As most of the babies with severe defects need to be managed in hospital after birth, it is a challenge for the family and the health care system.

Over the past decades, the Maldives has experienced a marked reduction in infant and under-five mortality rates (Maldives Bureau of Statistics, 2024). Consequently, congenital anomalies have emerged as a leading cause of infant and child mortality, consistently ranking among the top four causes in recent years (Christianson et al., 2006; Health Protection Agency, 2014; World Health Organization, Regional office for South-East Asia, 2016).

In the present survey, the most frequently reported congenital anomalies involved the circulatory system (28.7%), followed by the musculoskeletal system (16%), digestive system (13%), and genital organs (10%). These findings are consistent with trends observed in the previous national birth defect report, although that report identified nervous system anomalies as the third most reported category (Health Protection Agency, 2014).

Circulatory System Anomalies

Congenital heart diseases (CHDs) represent the most prevalent category of birth defects globally, with an estimated incidence of 8 per 1,000 live births (Liu et al., 2019). In the Maldives, the reported prevalence is comparable, at approximately 7.9 per 1,000 live births (Christianson et al., 2006). In the present survey, a total of 344 anomalies (20 defects per 1000 live births) involving the circulatory system were documented. There is a variation in incidence of CHDs in different countries, and in term and preterm babies. It also varies depending on the inclusion of mild and severe defects (Hoffman & Kaplan, 2002). In a study done in India, incidence of congenital heart defects were significantly higher in preterm than term babies (22.69 vs 2.36 per 1000 live births) respectively (Khalil et al., 1994).

Atrial septal defect (ASD) was the most frequently observed cardiac anomaly, accounting for 110 cases (6.4 per 1000 live births, 32% of CHDs), consistent with findings from the previous national birth defect report (HPA, 2014). Patent ductus arteriosus (PDA) was the second most reported defect (86 cases, 5 per 1000 live births, 25% of CHDs), although it may represent a physiological variant in preterm neonates (Swain, Agrawal, & Bhatia, 1994). Ventricular septal defect (VSD) ranked third, with 61 cases identified (3.5 per 1000 live births, 17.7% of CHDs). In a study done in Jordan, PDA, VSD and ASD had the prevalence of 44, 25, and 25% respectively. The higher prevalence of PDA in that study is likely due to the high percentage of preterm infants (51%) in the study population (Khasawneh et al., 2020).

Musculoskeletal Anomalies

Musculoskeletal anomalies are recognized globally as amongst the most prevalent categories of congenital disorders. In this survey, the most frequently reported musculoskeletal anomalies were congenital talipes equinovarus (CTEV) (76 cases, 4 per 1000 live births). A study done in Pakistan showed incidence of CTEV as 9.7% (Ain et al., 2022). The higher percentage in that study compared to our study is likely because of population bias, as the data is based on patients who presented to the hospital.

Other anomalies noted were polydactyly (34 cases, 2 per 1000 live births), and syndactyly (9 cases, 0.5 per 1000 live births). A Korean study showed similar incidence for polydactyly (1.2 per 1000 live births) and syndactyly (0.3 per 1000 live births) (Shin et al., 2021).

Additionally, congenital diaphragmatic hernia was identified in 4 cases (0.2 per 1000 live births). These findings are consistent with the Birth Defects Report 2008–2014, which also ranked musculoskeletal anomalies as the second most commonly reported group (Health Protection Agency, 2014).

Gastrointestinal and Genital Anomalies

Ankyloglossia was the most frequently reported anomaly in this survey, with 113 documented cases (6.6 per 1000 live births). Reports of incidence of ankyloglossia vary from 48 to 810 per 1000 live births (Messner et al., 2000; Aldebei, 2016). The significantly high rate of incidence in these reports was likely due to targeted examination and population selection of the patients that presented to referral clinics for frenulotomy. Other anomalies included congenital absence, atresia, or stenosis of the anus without fistula, observed in 8 cases (0.45 cases per 1000 live births).

Among genital anomalies, undescended testes was the most prevalent (68 cases, 4 per 1000 live births), with unilateral undescended testis being the most recorded subtype. A systematic review by Sijstermans et al. (2008) revealed that the incidence of undescended testis varies from 10 to 46 per 1000 live births, depending on the gestation, birth weight and age of examination. Hypospadias was the next most frequently found genital anomaly in our study (23 cases, 13.4 per 10000 live births). A review of literature by Springer, van den Heijkant & Baumann (2016) showed a varying prevalence across the world with prevalence in Europe 19.9 (range: 1–464), North America 34.2 (6–129.8), South America 5.2 (2.8–110), Asia 0.6–69, Africa 5.9 (1.9–110), and Australia 17.1–34.8 per 10,000 live births.

Other Anomalies

Anomalies affecting the eye, ear, face, and neck represented the fifth most frequently reported category in this survey, with accessory auricular tag being the most observed anomaly within this group. The sixth most frequently reported anomalies involved the nervous system, urinary system, and chromosomal abnormalities. Among nervous system anomalies, congenital hydrocephalus was the most prevalent (16 cases), followed by microcephaly (10 cases). Compared to the Birth Defects Report 2008–2014, which ranked nervous system anomalies as the third most common category, the current findings reflect a lower incidence

(Health Protection Agency, 2014). This decline may suggest improved antenatal care and increased post-conception folic acid supplementation, contributing to the prevention of neural tube defects (World Health Organization, Regional Office for South-East Asia, 2016). However, our study did not specifically analyze the association between folic acid intake and anomaly prevalence, nor did it capture the timing of supplementation.

Microcephaly, while less frequent than hydrocephalus, was not rare. Routine screening for Zika virus and TORCH infections is conducted for all identified cases of microcephaly. Among chromosomal anomalies, Down syndrome was the most frequently reported condition, with 43 documented cases. Within urinary system anomalies, congenital hydronephrosis was the most prevalent, accounting for 18 cases (38% of urinary system anomalies with incidence of 1.05 per 1000 live births). A study done in King Abdulaziz University Hospital showed a much higher incidence of 16.6 per 1000 live births accounting for 95.7% of the urinary system (Kari et al., 2013). That study mentioned the possible reason for increased incidence as the low cut off value used to define hydronephrosis.

Respiratory tract anomalies were the least frequently reported in this survey. Pulmonary hypoplasia and dysplasia were the predominant conditions within this category. Despite their lower frequency, these anomalies were associated with high neonatal mortality (22% of deaths), making respiratory defects the leading cause of birth defect related neonatal deaths. This pattern aligns with findings from the Birth Defects Report 2008–2014, which documented a 64% mortality rate among cases of pulmonary agenesis and hypoplasia (Health Protection Agency, 2014)

Limitations

This study was conducted at a single institution—Indira Gandhi Memorial Hospital—the tertiary government referral center in the Maldives. While IGMH accounts for approximately one-third of all deliveries nationwide, the findings may not be fully generalizable to the broader Maldivian population.

The analysis was restricted to congenital anomalies classified under the Chapter XVII of the International Classification of Diseases, 10th Revision (ICD-10). As a result, congenital anomalies that are not captured within this coding framework—such as metabolic conditions and hematological disorders including thalassemia and glucose-6-phosphate dehydrogenase (G6PD) deficiency—were excluded, despite their known higher prevalence in the Maldives.

Stillbirths and intrauterine fetal deaths (IUFDs) were also excluded from the dataset. This may have led to underrepresentation of anomalies associated with these outcomes, potentially resulting in an underestimation of the overall burden of congenital disorders.

Additionally, incomplete documentation of maternal data for deliveries without birth defects limited the capacity to conduct comparative analyses and assess the statistical significance of potential risk factors.

Conclusions and Recommendations

This hospital-based survey provides the most comprehensive documentation of birth defects in the Maldives to date, offering valuable insights into the prevalence

and patterns of congenital anomalies within a tertiary care setting. Circulatory system anomalies, particularly atrial septal defects, emerged as the most frequently reported category, followed by musculoskeletal, digestive, and genital anomalies. The observed decline in nervous system anomalies compared to previous national data may reflect improvements in antenatal care and folic acid supplementation, although further investigation is warranted.

Despite its strengths, the study highlights critical gaps in national surveillance, including the exclusion of stillbirths, metabolic and hematological anomalies, and incomplete maternal data for unaffected births. These limitations underscore the need for a more inclusive and representative surveillance system to accurately estimate the burden of congenital disorders and inform targeted prevention and care strategies.

As infant and child mortality rates continue to decline in the Maldives, birth defects are becoming an increasingly prominent contributor to early childhood morbidity and mortality. Strengthening surveillance, expanding diagnostic capacity, and integrating preventive interventions into maternal and child health programs will be essential to reduce the impact of congenital anomalies and improve outcomes for affected children and families.

Recommendations

Based on the findings and limitations of this study, the following recommendations are proposed to strengthen congenital anomaly surveillance and improve child health outcomes in the Maldives:

Expand Surveillance Coverage

National birth defect surveillance should be extended beyond a single tertiary facility to include regional hospitals and peripheral health centres. This will improve generalizability and enable more accurate estimation of the national burden.

Include Non-Q Code Anomalies

Future surveillance efforts should incorporate congenital conditions not classified under the ICD-10 ,Chapter XVII, particularly metabolic and haematological disorders such as thalassemia and G6PD deficiency, which are prevalent in the Maldivian population.

Integrate Stillbirths and IUFDs

Surveillance systems should include stillbirths and intrauterine fetal deaths to capture anomalies associated with these outcomes and avoid underestimation of the total burden.

Strengthen Maternal Data Collection

Comprehensive documentation of maternal health parameters for all deliveries, including those without birth defects, is essential to facilitate comparative analyses and identify risk factors.

Monitor Folic Acid Supplementation

Systems should be established to track the timing, coverage, and adherence to folic acid supplementation during pregnancy to evaluate its role in preventing neural

tube defects.

Enhance Neonatal Screening and Referral Pathways

Standardized protocols for early detection and referral of congenital anomalies—particularly cardiac, neurological, and genitourinary defects—should be implemented to improve timely intervention.

Expand Genetic and Infectious Disease Screening

Routine TORCH and Zika virus screening for microcephaly should continue, and genetic testing capacity should be strengthened to support diagnosis of chromosomal anomalies.

Prioritize High-Mortality Anomalies

Given their disproportionate contribution to neonatal mortality, respiratory tract anomalies should be prioritized for clinical guideline development, early diagnosis, and referral.

Promote Community Awareness and Antenatal Education

Public health campaigns should emphasize the importance of early antenatal care, nutritional supplementation, and birth defect prevention strategies.

Inform Policy and Program Development

Surveillance data should be actively used to guide national child health policies, resource allocation, and the design of congenital anomaly prevention and care programs.

Ethical approval

This study was approved by the ethics committee of Indira Gandhi Memorial Hospital and National Health Research Council (NHRC) of Maldives. The NHRC approval letter was dated 24th October 2019.

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Conflicts of interest

All authors state that there are no conflicts of interest.

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Submission Declaration and Verification

This article is not published elsewhere nor under consideration for publication by another source. All the authors approved the publication, and if accepted the article will not be published elsewhere without a written consent of the MNJR.

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