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Prevalence of congenital anomalies in the Dutch Caribbean islands of Aruba, Bonaire, and Curaçao

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Abstract

Background: Congenital anomalies represent an important global health issue. Data on the prevalence and pattern of congenital anomalies in the Caribbean region are scarce and lacking altogether in Aruba, Bonaire and Curaçao (ABC islands).

Methods: We performed a population-based surveillance study to determine the prevalence of structural congenital anomalies in the ABC islands, including all live births and stillbirths between January 1, 2008 and December 31, 2017 with major congenital anomalies according to EUROCAT guide 1.5. Terminations of pregnancy for fetal anomaly were included as well. Cases were identified by active case ascertainment, using multiple sources including pediatric patient files and discharge letters, delivery records, and clinical genetic patient files. Total and subgroup prevalence rates were compared between the three islands and to the French West Indies and Northern Netherlands.

Results: Total prevalence of congenital anomalies on the ABC islands was 242.97 per 10,000 births. Total prevalence of congenital anomalies in Bonaire (325.15 per 10,000 births) was higher compared to Aruba (233.29 per 10,000 births) and Curaçao (238.58 per 10,000 births), which was mainly attributable to a higher prevalence of limb anomalies, in particular polydactyly, in Bonaire. Total prevalence of congenital anomalies on the ABC islands was comparable to the French West Indies (248.69 per 10,000 births) but significantly lower compared to the Northern Netherlands (298.98 per 10,000 births). In the subgroup prevalence analysis, the prevalence of polydactyly and atrial septal defect on the ABC islands was significantly higher compared with the French

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West Indies and the Northern Netherlands, while the prevalence of congenital anomalies of the kidney and urinary tract and genetic disorders was significantly lower.

Conclusions: This is the first study to establish the prevalence and pattern of congenital anomalies on the ABC islands, which is important to inform healthcare managers and policymakers and to provide a basis for continuous surveillance of congenital anomalies.

KEYWORDS

ABC islands, birth defects, congenital malformations, Dutch Caribbean, prevalence, West Indies

1 | INTRODUCTION

Congenital anomalies, also known as birth defects or congenital malformations, can be defined as structural or functional anomalies that are present at birth. They may be caused by genetic, maternal, and environmental factors, although in most cases the exact cause remains unknown (World Health Organization, 2022a, 2022b). The worldwide live birth prevalence of congenital anomalies is estimated to be 3%–6% (Kirby, 2017; World Health Organization). However, estimates vary widely across registries, which is to a large extent attributable to differences in surveillance methods and inclusion and exclusion criteria, but may also reflect true differences in prevalence rates, related for example to genetic or environmental factors (Kirby, 2017). Congenital anomalies represent a major global health issue and are an important cause of perinatal, neonatal, infant and child morbidity and mortality, as well as long-term disability (Liu et al., 2016; Murray et al., 2012). The proportion of congenital anomalies contributing to overall child mortality has increased in particular in regions where under-five mortality rates declined because other causes of child mortality such as infectious diseases and malnutrition were controlled (Christianson et al., 2006; Liu et al., 2016; World Health Organization, 2022a, 2022b).

Accurate local prevalence data on congenital anomalies are important to better understand the extent of the problem and to guide healthcare policies that aim to prevent congenital anomalies and to provide care and support to affected individuals (Melo et al., 2021). In 2010, the World Health Assembly published a resolution urging member states to develop and strengthen registration and surveillance systems for birth defects (World Health Assembly; 63, 2010). However, there is still a paucity of prevalence data on congenital anomalies in many parts of the world, especially in resource-limited areas. A more recent consensus statement on congenital anomalies in Latin America and the Caribbean listed improved surveillance and epidemiologic research as key action points to improve birth defects prevention and care (Zarante et al., 2019).

In this study, we aim to estimate the prevalence and pattern, that is, the prevalence of different subgroups, of structural congenital anomalies on the Dutch Caribbean islands of Aruba, Bonaire, and Curaçao (ABC islands). These islands are part of the Kingdom of the Netherlands and are located in the Caribbean Sea, near the coast of Venezuela. Besides establishing baseline prevalence rates, we will compare the prevalence data of the ABC islands with those of two EUROCAT registries: the French West Indies (Guadeloupe and Martinique) and Northern Netherlands. The French West Indies are comparable to the ABC islands in terms of geographical location, as these islands are also located in the Caribbean Sea, and in terms of ancestral background, as their population is mainly of African descent (Mendisco et al., 2019). The rationale behind comparison with the Northern Netherlands is that the ABC islands are part of the Kingdom of the Netherlands. Comparison with these two EUROCAT registries will allow better interpretation of the prevalence and pattern of congenital anomalies on the ABC islands.

2 | METHODS

2.1 | Study setting

The ABC islands are part of the Kingdom of the Netherlands, although their legal status differs: Aruba and Curaçao are constituent countries, while Bonaire is a special municipality within the country of the Netherlands.

The healthcare systems of ABC islands largely mirror that of the Netherlands, with a general practitioner as the

first point of contact and secondary care being provided at general hospitals. Certain specialized care that is not locally available is provided through medical transfers to overseas hospitals and by medical specialists visiting from abroad. All legal residents are entitled to a basic health insurance, which is paid through income tax.

Curaçao is the largest island with a population of 153,671 (Central Bureau of Statistics Curaçao, 2022b) and ~1,500 to 2,000 births per year. There are two hospitals, of which Curaçao Medical Center (CMC) is the largest hospital. CMC opened in 2019 and replaced the Sint-Elisabeth Hospital (SEHOS). It provides all major medical specialties and is the only hospital in Curaçao that provides obstetric and pediatric care, including pediatric cardiology and a neonatal intensive care unit (NICU). Outpatient pediatric services are also offered at a number of private clinics. Approximately 80% of deliveries in Curaçao take place at the CMC (H. Holtsema, personal communication). Prenatal ultrasound to detect structural anomalies in the second trimester is offered to all pregnant women. Screening for Down's syndrome, Edwards' syndrome and Patau's syndrome through noninvasive prenatal testing (NIPT) or the "combined test" is performed only sporadically. NIPT is covered by health insurance for women ≥40 years old and/or with a medical indication. Invasive prenatal testing is not available, but can be performed in Aruba or Colombia. Termination of pregnancy (TOP) is prohibited by law, although there has been an "institutionalized tolerance" policy since 1999. Under this policy, TOP for fetal defects with a great likelihood of causing death within 1 year after birth is tolerated after approval of the hospital's ethical board (Boersma et al., 2012).

Aruba has a population of 107,457 (Central Bureau of Statistics Aruba, 2022), with ~1,200 to 1,300 births per year. There is one general hospital, the Dr. Horacio E. Oduber Hospital (HOH), where all major medical specialties are provided, including obstetric and pediatric care. The pediatric cardiologist of the CMC visits the HOH on a regular basis to evaluate patients with (suspected) heart disease. The majority of deliveries take place at the HOH. Prenatal ultrasound to detect structural anomalies in the second trimester is offered to all pregnant women. Screening for Down's syndrome, Edwards' syndrome and Patau's syndrome is performed through the "combined test" or NIPT, with an uptake of approximately 41%. NIPT was paid out-of-pocket up until October 2021, but due to unavailability of the "combined test" it is now offered as part of the standard care to all pregnant women after counseling and covered by the national health insurance. Invasive prenatal testing is performed at the HOH and is covered by health insurance. TOP for medical indication is discussed on a case basis before it can be offered and has to be carried out before 24 weeks of gestation.

Bonaire is the smallest of the three islands, with a population of 21,745 (Statistics Netherlands, 2021) and ~250 births per year. Secondary care, including obstetric and pediatric care, is provided at the hospital Fundashon Mariadal (FM), where all deliveries on the island take place. All pregnant women are offered prenatal ultrasound to detect structural anomalies in the second trimester. NIPT for fetal aneuploidies is offered to pregnant women of 36 years and above and covered by health insurance. NIPT for women below the age of 36 years is only performed on request and has to be paid out-of-pocket. Women are referred to the HOH on Aruba if there is an indication for invasive prenatal testing. TOP was legalized after October 10, 2010, when Bonaire became a special municipality of the Netherlands.

On all three islands, a lack of certain (highly) specialized care leads to a relatively high mobility around birth, particularly in Bonaire where pediatric care is least advanced. For example, pregnant women from Aruba and Bonaire may be transferred to Curaçao or Colombia when a (very) preterm birth is expected and pregnant women from Curaçao may be transferred to Colombia when neonatal surgery is required.

Autopsy after fetal or neonatal death is very rarely performed on the ABC islands.

2.2 | Study design and population

We performed a population-based surveillance study. All children born between January 1, 2008 and December 31, 2017 with at least one structural congenital anomaly, whose mother was living on the ABC islands at the time of delivery, were included in the study. Stillbirths with a gestational age ≥ 20 weeks and/or birthweight >500 g were also included, as were terminations of pregnancy for fetal anomaly (TOPFA). To enable comparison with other registries, we only included cases with major structural congenital anomalies according to EUROCAT, a European network of population-based registries for the epidemiological surveillance of congenital anomalies, guide 1.5 (EUROCAT, 2022). Major congenital anomalies are defined as structural changes that have significant medical, social, or cosmetic consequences for the affected individual, and typically require medical intervention.

2.3 | Outcomes

We calculated the total and subgroup prevalence rates on the ABC islands and compared these between the three

islands. In addition, total and subgroup prevalence rates of the ABC islands were compared to EUROCAT prevalence data of the French West Indies (Guadeloupe and Martinique) and the Northern Netherlands. Congenital anomalies were classified in subgroups and clustered into 12 categories in accordance with EUROCAT guide 1.5, Chapter 3.3. These 12 categories are: (1) nervous system anomalies, (2) eye anomalies, (3) ear, face and neck anomalies, (4) congenital heart defects, (5) respiratory anomalies, (6) oro-facial clefts, (7) gastro-intestinal anomalies, (8) abdominal wall defects, (9) congenital anomalies of kidney and urinary tract, (10) genital anomalies, (11) limb anomalies, and (12) genetic disorders. In contrast to the EUROCAT guide, we did not further classify the category oro-facial clefts into the subgroups "cleft lip with or without cleft palate" and "cleft palate," as this information was often not recorded in the medical files, resulting in a total of 102 anomaly groups instead of 104.

2.4 | Data collection

Cases were identified by active case ascertainment (2018–2020), using multiple sources including pediatric patient files, pediatric discharge letters and delivery records (in which all live births as well as stillbirths and TOP are registered) from the HOH, FM, CMC, and SEHOS. Additionally, NICU records from the CMC, outpatient medical records from private pediatric clinics in Curaçao, and patient files from the bi-annual joint pediatric-genetics clinics on the ABC islands were searched. Detailed information on each congenital anomaly was collected, as well as additional data, including sex, birth plurality, year of birth, place of birth, type of birth, birth weight, and maternal age.

Livebirth statistics were obtained from the Central Bureau of Statistics (CBS) of Aruba (Central Bureau of Statistics Aruba, 2022), Curaçao (Central Bureau of Statistics Curaçao, 2022a) (Central Bureau of Statistics Curaçao, personal communication) and Caribbean Netherlands (Statistics Netherlands, 2016, 2022). The CBS corrects for the high mobility around birth in their live birth statistics by registering live born children by the municipality registration of the mother, even if the child was born somewhere else. However, this only applies to children who arrive in Bonaire within the first 45 days of their life. After 45 days, the child is counted as an immigrant. There are no official data on the number of stillbirths on the ABC islands. Therefore, the delivery records of the HOH, FM, and SEHOS were searched to determine the total number of stillbirths during the study period.

Data on prevalence of congenital anomalies in the French West Indies (Guadeloupe and Martinique) from 2009 to 2018 (data not available for 2008) and the Northern Netherlands from 2008 to 2017 were derived from the online EUROCAT data registry (https://eu-rd-platform.jrc.ec.europa.eu/eurocat/eurocat-data/prevalence/export/, accessed on July 25, 2022).

2.5 | Data analysis

Total and subgroup prevalence of congenital anomalies was calculated as described in EUROCAT guide 1.5 (EUROCAT, 2022):

$$\text{Prevalence} = \frac{\text{Number of cases(live births + stillbirths + TOPFA)}}{\text{Number of births(live births + stillbirths)}} \text{x } 10{,}000.$$

The 95% confidence intervals (CI) were calculated using the Poisson distribution. A child/fetus with several major anomalies was counted once within each anomaly group. Thus, the number of cases in various anomaly groups cannot be added to reach a total number. In any given prevalence, a child/fetus was counted only once. For example, a child with Down syndrome and atrioventricular septal defect (AVSD) is counted once in the overall prevalence rate of congenital anomalies, once in the category congenital heart defects (CHD), once in the subgroup severe CHD, once in the subgroup AVSD, once in the category genetic disorders and once in the subgroup Down syndrome/trisomy 21.

Chi-square test was used to test differences in baseline characteristics and prevalence rates. Two-tailed Fisher's exact test or Fisher–Freeman–Halton exact test was used if more than 20% of cells of the contingency table had an expected value of <5. A p-value of <.05 was considered to be statistically significant. A Bonferroni correction for multiple comparisons was applied for comparing prevalence rates of each of the 102 anomaly groups ($p = .05/102 = .00049$). Data were analyzed using SPSS version 26 and Microsoft Excel 2016. An online statistics tool was used to calculate Fisher's exact tests (https://www.socscistatistics.com/tests/fisher/default2.aspx).

2.6 | Ethical statement

The study was approved by the Medical Ethical Committee and/or Board of Directors of the HOH, FM, and CMC. Verbal consent for the study was obtained from the children's caregivers by telephone. This was

TABLE 1 Baseline characteristics of children/fetuses with congenital anomalies.

	Aruba $n = 303$	Bonaire $n = 68$	Curaçao $n = 464$	p-value	Total $n = 835$
Sex					
Male (%)	165 (56)	41 (62)	258 (56)	.68	464 (56)
Female (%)	131 (44)	25 (48)	204 (44)		360 (44)
Place of birth					
Same as residence mother (%)	289 (95)	54 (79)	457 (98)	<.00	800 (96)
Plurality					
Singleton (%)	299 (99)	61 (90)	444 (96)	<.01	804 (96)
Twins (%)	4 (1)	7 (10)	20 (4)		31 (4)

TABLE 2 Total prevalence of congenital anomalies in Aruba, Bonaire, and Curaçao.

	Aruba	Bonaire	Curaçao	Total
Number of cases	303	68	464	835
Total prevalence per 10,000 births (95% CI)	233.29 (207.78–261.08)	352.15 (273.51–446.38)	238.58 (217.38–261.30)	242.97 (226.77–260.01)

Note: Prevalence was calculated as follows: number of cases (live births + stillbirths + TOPFA)/number of births (live births + stillbirths) × 10,000.
Abbreviations: CI, confidence interval; TOPFA, termination of pregnancy for fetal anomaly.

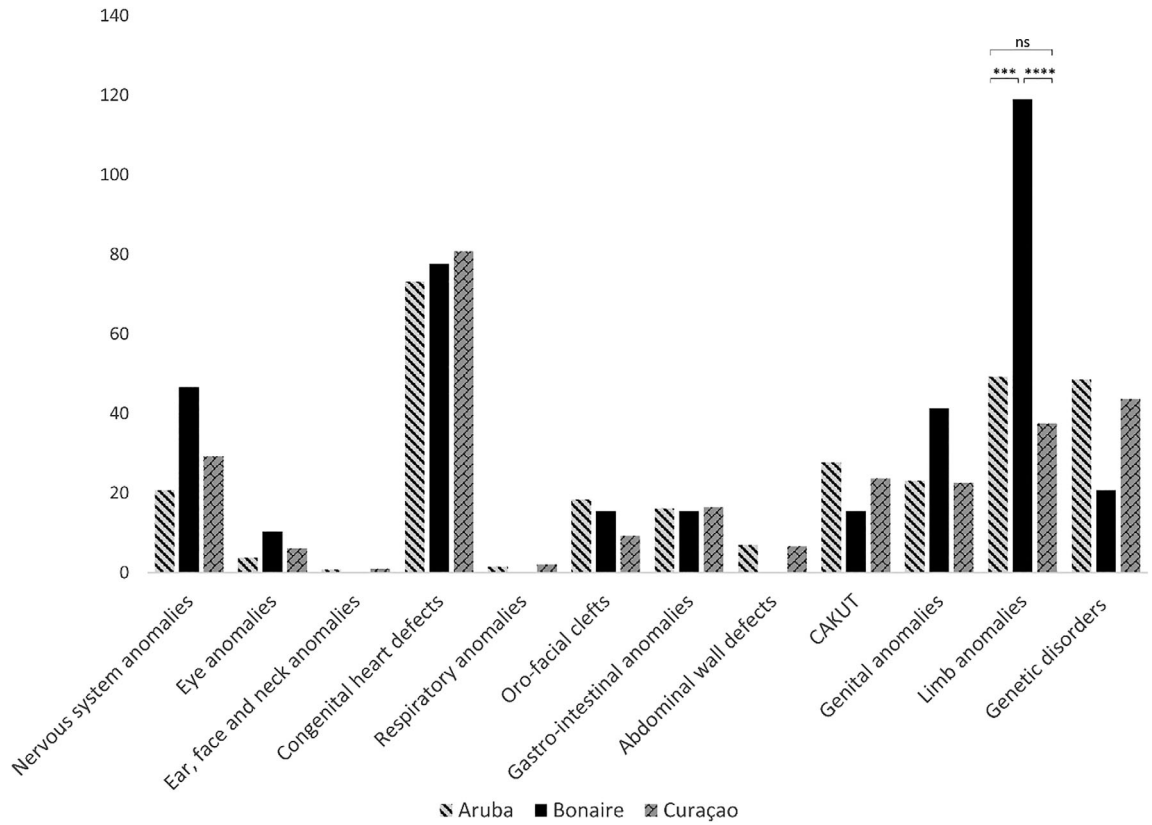

FIGURE 1 Prevalence of congenital anomalies per main subgroup in Aruba, Bonaire, and Curaçao (per 10,000 births). CAKUT, congenital anomalies of the kidney and urinary tract, ns, not significant, ***p-value <.001, ****p-value <.0001.

followed by an email with a summary of the information that was discussed and written information about the study, as well as instructions on how to revoke consent. If we were unable to reach caregivers, all personal data of the child were deleted and the case was included anonymously.

TABLE 3 Prevalence of congenital anomalies on the ABC islands, French West Indies, and Northern Netherlands (total and per category).

	Prevalence per 10,000 births (95% CI)		
	ABC islands $n = 835$	**French West Indies $n = 2,327$**	**Northern Netherlands $n = 4,953$**
All anomalies	242.97 (226.77–260.01)	248.69 (238.69–259.00)	298.98 (290.71–307.43)
Nervous system anomalies	27.06 (21.85–33.15)	39.12 (35.21–43.33)	26.86 (24.43–29.48)
Eye anomalies	5.53 (3.33–8.64)	5.66 (4.24–7.41)	8.09 (6.78–9.58)
Ear, face, and neck anomalies	0.87 (0.17–2.57)	4.27 (3.05–5.82)	3.20 (2.40–4.18)
CHD	77.69 (68.66–87.59)	59.63 (54.79–64.79)	84.93 (80.55–89.49)
Respiratory anomalies	1.75 (0.63–3.81)	4.81 (3.51–6.43)	4.29 (3.35–5.41)
Oro-facial clefts	13.09 (9.55–17.52)	8.12 (6.40–10.17)	20.70 (18.57–23.01)
Gastro-intestinal anomalies	16.29 (12.31–21.16)	17.10 (14.55–19.96)	19.07 (17.03–21.30)
Abdominal wall defects	6.40 (4.01–9.69)	10.26 (8.31–12.53)	6.58 (5.40–7.94)
CAKUT	24.73 (19.76–30.58)	43.92 (39.78–48.38)	45.94 (42.73–49.32)
Genital anomalies	23.86 (18.98–29.61)	25.54 (22.41–28.99)	28.85 (26.33–31.56)
Limb anomalies	46.56 (39.63–54.35)	38.79 (34.91–43.00)	60.24 (56.56–64.10)
Genetic disorders	44.23 (37.48–51.84)	76.09 (70.61–81.89)	67.37 (63.47–71.44)

Note: Prevalence was calculated as follows: number of cases (live births + stillbirths + TOPFA) / number of births (live births + stillbirths) *10,000. The complete list of congenital anomalies in the ABC islands, French West Indies and Northern Netherlands including p-values can be found in Table S2
Abbreviations: ABC, Aruba, Bonaire, Curaçao; CAKUT, congenital anomalies of the kidney and urinary tract; CHD, congenital heart defects; CI, confidence interval; TOPFA, termination of pregnancy for fetal anomaly.

3 | RESULTS

A total of 34,367 births (live and stillbirths) were recorded during the study period. There were 873 children/fetuses who met the inclusion criteria. Caregivers of 38 children (4.4%) declined participation in the study or revoked their consent and these children were thus not included (2.6% in Aruba, 13.9% in Bonaire, and 3.9% in Curaçao). A total of 835 children/fetuses were included in the study: 303 from Aruba, 68 from Bonaire, and 464 from Curaçao. Baseline characteristics are shown in Table 1. Mean birth weight and maternal age were not calculated because of too many missing data.

Total prevalence of congenital anomalies in the ABC islands was 242.97 per 10,000 births (95% CI: 226.77–260.01). In Bonaire the total prevalence was higher compared to Aruba and Curacao ($p = .0018$ and $p = .0022$, respectively) (Table 2). Total prevalence of congenital anomalies did not differ significantly between Aruba and Curaçao.

Prevalence per congenital anomaly category for each island is shown in Figure 1. The prevalence of limb anomalies was significantly higher in Bonaire compared with Aruba (119.11 vs. 49.28, $p = .0002$) and Curaçao (119.11 vs. 37.54, $p < .0001$). This was mainly attributable to a higher prevalence of polydactyly in Bonaire (82.86 per 10,000 births) compared to Aruba (33.11 per 10,000 births) and Curaçao (22.11 per 10,000 births) (Table S1). There was no statistically significant difference between the three islands for any of the other categories. An overview of prevalence rates for all 102 anomaly subgroups for each island can be found in Table S1.

Total and subgroup prevalence of congenital anomalies in the ABC islands were compared with those in the French West Indies and the Northern Netherlands (Table 3, Table S2). Total prevalence of congenital anomalies did not differ significantly between the ABC islands and the French West Indies (242.97 vs. 248.69 per 10,000 births, p-value .87), but it was significantly lower in the ABC islands compared to the Northern Netherlands (242.97 vs. 298.98 per 10,000 births, p-value <.0001). In the subgroup prevalence analysis, four out of the 102 anomaly groups showed a statistically significant difference in prevalence rate between the ABC islands and the French West Indies as well as the Northern Netherlands (Table S2). The prevalence of atrial septal defect was 23.28 per 10,000 births in the ABC islands, compared with 7.59 in the French West Indies (p-value <.0001) and 9.84 in the Northern Netherlands (p-value <.0001). The prevalence of polydactyly was also significantly higher in the ABC islands compared with the French West Indies and the Northern Netherlands (29.68 vs., respectively 10.47 and 13.34 per 10,000 births, both p-values <.0001). Congenital anomalies of the kidney and urinary tract (CAKUT) were less prevalent in the ABC islands (24.73 per 10,000 births) compared to the French

West Indies (43.92 per 10,000 births, *p*-value <.0001) and the Northern Netherlands (45.94 per 10,000 births, *p*-value <.0001). Finally, the prevalence of genetic disorders was lower in the ABC islands (44.23 per 10,000 births) compared with the French West Indies (76.09 per 10,000 births, *p*-value <.0001) and the Northern Netherlands (67.37 per 10,000 births, *p*-value <.0001).

4 | DISCUSSION

In this study we established a total prevalence of congenital anomalies on the ABC islands of 242.97 per 10,000 births (95% CI: 226.77–260.01) in the period 2008 to 2017. The prevalence in Bonaire (325.15 per 10,000 births) was higher compared to Aruba (233.29 per 10,000 births) and Curaçao (238.58 per 10,000 births). The total prevalence of congenital anomalies on the ABC islands was comparable to the prevalence in the French West Indies, although it was significantly lower than the prevalence in the Northern Netherlands during the same period.

The strength of our study is that we performed a population-based study including all types of births and followed recent EUROCAT guidelines on in- and exclusion criteria for congenital anomalies. This allowed for more unbiased comparison with other EUROCAT registries, like the population-based EUROCAT registries of the French West Indies and the Northern Netherlands, which also include all types of births (EUROCAT members: French West Indies, 2022; EUROCAT members: Northern Netherlands, 2022).

A limitation of our study is that insufficient medical information prompted us to exclude some children/fetuses, which may have led to an underestimation of the prevalence rate of congenital anomalies. For example, atrial septal defect type II is only included in the EUROCAT registry if there is still flow across the defect 6 months after birth (corrected for gestational age) and patent ductus arteriosus only in term babies (gestational age ≥ 37 weeks) after surgery/catheter closure or if still present 6 months after birth. Children were not included in our study if follow-up and/or necessary medical information was not documented.

When comparing the ABC islands to each other, we found a higher prevalence of congenital anomalies in Bonaire compared to Aruba and Curaçao. This may be explained by the higher percentage of twins in Bonaire, as these pregnancies are associated with a higher risk of congenital anomalies (Dawson et al., 2016), but methodological differences may also play an important role. The very small size of Bonaire, with only ~250 births per year, allowed a more thorough search of the medical files and thus it is likely that ascertainment for less severe congenital anomalies was better. Indeed, we found a significantly higher prevalence of polydactyly in Bonaire compared to Aruba and Curacao. In addition, mobility around birth is higher in Bonaire compared to Aruba and Curacao, and determination of the number of live births by the CBS is different. Children who are born abroad are registered by the municipality registration of the mother, but only if the child arrives in Bonaire within the first 45 days of life. The total number of live births as registered by the CBS—which was used to calculate the denominator data in this study—will thus underestimate the true number of live births, leading to an overestimation of the prevalence rate of congenital anomalies. On the other hand, the percentage of children's caregivers who declined participation was highest in Bonaire (13.9% compared to 2.6% and 3.9% in Aruba and Curaçao, respectively), which may lead to a slight underestimation of the prevalence in Bonaire. We believe this difference might be (partially) explained by privacy concerns that caregivers may have had related to the very small size of Bonaire.

The total prevalence of congenital anomalies on the ABC islands was significantly lower compared to the Northern Netherlands, which might be explained by the availability of more advanced diagnostic technologies. When comparing the different subgroups of congenital anomalies between the ABC islands and the French West Indies and Northern Netherlands, we found that the prevalence of polydactyly (29.68 per 10,000 births) and atrial septal defect (23.28 per 10,000 births) was significantly higher in the ABC islands. The high prevalence of polydactyly can be explained by the African ancestry of a large part of the population of the ABC islands, especially in Curaçao and Bonaire. It has long been known that postaxial polydactyly is common in individuals of African ancestry (Scott-Emuakpor & Madueke, 1976; Woolf & Myrianthopoulos, 1973), with an apparently autosomal dominant inheritance pattern with incomplete penetrance (Holmes et al., 2018). Although the type of polydactyly was not registered in this study, there is anecdotal evidence that most cases of polydactyly in the ABC islands are postaxial. The high prevalence of atrial septal defect might be explained by the availability of a pediatric cardiologist on Aruba and Curaçao, resulting in a low threshold for referral and overdiagnosis of relatively mild CHD. However, it is also possible that there is a truly high prevalence of atrial septal defect on the ABC islands, related to genetic and/or environmental factors. The prevalence of CAKUT (24.73 per 10,000 births) and genetic disorders (44.23 per 10,000 births) was significantly lower on the ABC islands compared with the French West Indies and Northern Netherlands. We hypothesize that the lower prevalence of genetic

disorders is mainly attributable to differences in diagnostic opportunities, as there are no local clinical genetics services in the ABC islands. The lower prevalence of CAKUT might also be explained by underdiagnosis, since the prevalence of CAKUT is influenced by the availability of prenatal ultrasound screening (Bakker et al., 2018). Possibly, uptake of prenatal ultrasound screening is lower in the ABC island than in the French West Indies and Northern Netherlands, although this cannot be confirmed as data on uptake are not available for the ABC islands.

4.1 | Future directions

Although data on maternal health in the ABC islands are scarce, some risk factors for congenital anomalies are known to be prevalent among the population of the ABC islands. For example, obesity (BMI ≥30.0 kg/m^2), a risk factor for congenital anomalies (Harris et al., 2017), is known to be twice as prevalent in Curaçao compared with the Netherlands (Verstraeten et al., 2018). We suggest to study women's health in the preconception period and during pregnancy on the ABC islands, with the aim of identifying certain risk factors, such as low uptake of preconceptional folic acid supplementation, for congenital anomalies that may be addressed in prevention programs. Moreover, further research may be aimed at identifying local risk factors for congenital anomalies. In Curacao, for example, there are many concerns about the health effects of an oil refinery that is located in the capital, Willemstad. Future studies may investigate if congenital anomalies are more prevalent in the surroundings of this oil refinery compared to other parts of Curaçao. In addition, the results of this study may be used for capacity planning of prenatal screening tests. For instance, the provided data on the prevalence of Down's syndrome, Edwards' syndrome, and Patau's syndrome support further implementation of NIPT to become available for all pregnant women in the Dutch Caribbean.

5 | CONCLUSIONS

This is the first study to report the prevalence and pattern of congenital anomalies in the ABC islands. The results of this study can be used to inform health care policies and may form an incentive to organize continuous surveillance programs in the Dutch Caribbean, in order to facilitate research, prevention, and care for individuals with congenital anomalies. In Curaçao, a first step has been made with the establishment of CaribCAT, a prospective surveillance program for congenital anomalies in the Dutch Caribbean.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to disclose.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ETHICS STATEMENT

The study was approved by the Medical Ethical Committee and/or Board of Directors of the Dr. Horacio E. Oduber Hospital, Fundashon Mariadal and Curaçao Medical Center.

PATIENT CONSENT STATEMENT

Consent for the study was obtained from the children's caregivers. If these could not be reached children were included anonymously.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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