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Neonatal Congenital Heart Defects at a Regional Referral Maternity in Western Romania, 2021–2022: Case Definition, Ascertainment, and the Antenatal Detection Gap

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Highlights

What are the main findings?

- Among 2909 live births at a regional referral maternity in Western Romania (2021–2022), two out of three newborns labeled as having a congenital heart defect had only transitional findings of the newborn circulation (an isolated interatrial communication, a patent ductus arteriosus, or both). Structural defects under a conservative study definition were found in 2.27% of births, and in at least 3.06% when the EUROCAT registration rules are applied.
- A heart defect was correctly recognized before birth, and documented in the hospital records, in only 4.5% of newborns with structural defects. Separately, an audit of the hospital's coding found that a translation error had created a false cluster of 36 cases of a rare malformation.

What are the implications of the main findings?

- Hospital-based figures for congenital heart defects should not be compared with population registries unless structural defects are separated from transitional findings, graded by anatomic complexity and checked against the original reports.
- Clear referral pathways to fetal echocardiography, especially when any fetal anomaly is suspected, are a quality-improvement priority for the region. Whether they work better than other approaches still needs to be tested in a prospective study.

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Abstract

Background/Objectives: Hospital neonatal series report congenital heart defect (CHD) frequencies well above registry figures, largely through case definition and ascertainment. We separated structural defects from transitional findings, graded anatomic complexity, audited coding, and quantified documented antenatal recognition in a Romanian referral maternity. Methods: This retrospective observational study reviewed all 2909 live births in Timisoara in 2021–2022. Neonates with abnormal findings on indicated echocardiography within 28 days were classified as structural CHD or transitional findings (isolated interatrial communication, patent ductus arteriosus, or both); structural cases received an American Heart Association (AHA) anatomic class. Proportions carry Wilson 95% confidence intervals (CIs). Results: Of 201 neonates with findings, 66 had structural CHD (2.27% of births; 95% CI 1.8–2.9): 44 AHA class I, 9 class II, 4 class III, 9 not gradable. Under EUROCAT rules it was at least 3.06% (89/2909), short of the extreme scenario counting every interatrial communication as a septal defect (6.50%). Concordant antenatal recognition was documented for 3 of 66 structural cases (4.5%; 95% CI 1.6–12.5) and 1 of 13 class II–III cases. Absent coarctation, valvar aortic stenosis and interrupted arch matched statistical expectation. A coding audit removed 36 spurious aortopulmonary communications. Conclusions: Two-thirds of neonatal CHD labels were transitional findings, and recognition of structural disease before birth was rare in available records. Tiered definitions, complexity grading and coding audits should precede epidemiologic claims from institutional cohorts.

Keywords: heart defects; congenital; neonatal screening; prenatal diagnosis; case definition; ascertainment bias; patent ductus arteriosus; patent foramen ovale; data accuracy; Romania

1. Introduction

Congenital heart defects (CHDs) are the most frequent group of major structural anomalies, with a birth prevalence of 8.2 per 1000 in the pooled worldwide literature [1] and 9.4 per 1000 in the most recent global meta-analysis covering 2010 to 2017 [2]. In Europe, the EUROCAT network recorded a total CHD prevalence of 8.0 per 1000 births for 2000 to 2005, of which severe defects accounted for 2.0 per 1000 [3]. Reported frequencies depend heavily on how cases are ascertained and defined: hospital series that rely on clinically indicated or low-threshold echocardiography capture many small shunt findings whose natural history is spontaneous closure, and they report figures several times higher than registries applying strict case definitions [4]. Ascertainment and case definition are themselves part of epidemiologic measurement, and comparisons between hospital series and registries are interpretable only when both are stated explicitly.

The anatomical substrate of that discrepancy is well characterized. The foramen ovale is patent in roughly one-quarter of unselected hearts at autopsy and in a majority of newborns [5], interatrial communications below 3 mm diagnosed in early infancy close spontaneously in essentially all cases and have been argued not to constitute a malformation at all [6], and ductal patency is expected physiology in the preterm infant, closing spontaneously in 85% of very-low-birth-weight infants managed conservatively [7,8]. EUROCAT registration rules accordingly exclude the patent foramen ovale and the patent ductus arteriosus in infants born before 37 weeks, whereas a secundum atrial septal defect, and a patent ductus as the only cardiac finding of a term infant, are registered as CHD [9]. A separate constraint concerns etiology: risk-factor analyses run on case series without controls, or on exposures represented by a handful of cases, produce associations that do not replicate [10,11].

The study window, 2021 to 2022, coincides with the COVID-19 pandemic. Pandemic-period cohorts have attracted attention after reports of more neonatal cardiac ultrasound abnormalities following maternal SARS-CoV-2 infection, mostly after infection before 8 weeks of gestation [12], and of a higher CHD prevalence after the first pandemic year [13], and the burden of SARS-CoV-2 in pregnancy at our own institution has been documented separately [14]. In the present study, the pandemic defines the observation period and its service context only; no etiologic question about maternal infection is asked or answered here.

Romanian data remain limited. A previous series from our center covering 2018 to 2022 described 541 newborns with CHD among 10,113 births, with an antenatal cardiac observation recorded for 151 of them (28%) [15]. That figure related any antenatal cardiac observation to all CHD labels, interatrial and ductal findings included, and it cannot be reproduced from the present re-extraction (Section 4.2). The present study examines the 2021 to 2022 portion of that experience with richer documentation and narrower questions: (i) what the echocardiographic case mix of a regional referral maternity contains once structural defects are separated from transitional findings and graded by anatomic complexity; (ii) how much of the structural disease carried a documented, concordant antenatal diagnosis in available records; and (iii) what a coding audit of the source database changes. The overlap with the earlier publication is tabulated in Supplementary Table S3.

2. Materials and Methods

2.1. Study Design and Setting

This is an original retrospective observational study, reported according to the STROBE recommendations [16]. It covered all live births managed by the Clinics of Obstetrics-Gynecology and Neonatology of the "Pius Brinzeu" County Clinical Emergency Hospital (PBCCEH), Timisoara, Romania, from 1 January 2021 to 31 December 2022. The unit functions as the regional referral maternity for several counties of Western Romania, with a level III neonatal care unit in the national designation; it receives high-risk pregnancies and preterm labor below 34 weeks from its catchment area. We describe the unit by these operational facts rather than by the label "tertiary center", since that term is used inconsistently across health systems. The birth register recorded 2909 live births in the two study years, and this count is the denominator of every frequency per live birth reported here.

2.2. Case Ascertainment

Neonates were included when transthoracic echocardiography performed by a pediatric cardiologist within the first 28 days of life documented any structural or shunt abnormality. Echocardiography was requested on clinical indication (murmur, cyanosis, respiratory distress, prematurity protocols, dysmorphism, or antenatal suspicion), so ascertainment was intensive but not universal; the indication for each examination was not retained as a structured field, so the distribution of indications cannot be reported (Section 3.8). Diagnoses were coded in the institutional database using ICD-10 categories Q20 to Q26 in the Baltimore-Washington classification tradition [17]. All examinations were performed and reported by a single pediatric cardiologist; no routine second reading was available, which Section 4.5 discusses. The number of neonates examined, including examinations with normal results, could not be recovered: the institutional database from which cases were extracted holds only neonates with abnormal findings, and a count of all examinations performed in the period was not part of the research extraction. Every frequency per live birth in this paper is therefore the number of neonates with an echocardiographically documented finding divided by all 2909 live births. It is a minimum frequency under indication-driven ascertainment, not a yield per examination and not a prevalence.

2.3. Case Definitions, Terminology, and Anatomic Classification

Each included neonate was assigned, before analysis, to one of two groups. The structural CHD group comprises any case containing a ventricular septal defect (VSD), tetralogy of Fallot (TOF), pulmonary artery stenosis, pulmonary atresia, Ebstein anomaly, hypoplastic left heart syndrome (HLHS), congenital mitral insufficiency, dextrocardia, discordant atrioventricular connection, anomalous pulmonary venous connection, aortopulmonary septal defect, or another specified Q20.8 lesion, alone or combined with an interatrial communication or patent ductus arteriosus (PDA). The transitional findings group comprises cases whose only findings were an isolated interatrial communication, an isolated PDA, or the two together. This boundary is narrower than the EUROCAT case definition. EUROCAT excludes the patent foramen ovale (PFO; Q21.11) and the PDA of infants born before 37 weeks, but registers the secundum atrial septal defect (ASD; Q21.10) and a PDA that is the only cardiac finding of a term infant [9]. Because the records cannot separate secundum ASD from PFO, the primary structural group is a conservative study definition rather than a registry-aligned one; a EUROCAT-aligned count is derived in Section 2.7.

Terminology is used as follows throughout. "Interatrial communication" (IAC) denotes any interatrial shunt for which the source records do not establish septal morphology; "secundum ASD" and "PFO" are used only where that distinction is documented or discussed as such. A PFO and a true secundum ASD are anatomically distinct, and some neonatal IACs are genuine septal defects [5,6]. The echocardiographic reports underlying this database, generated for clinical rather than research purposes, did not retain defect diameter, rim deficiency, shunt direction or follow-up status in a recoverable form, so the two entities cannot be separated retrospectively. All isolated IACs are therefore reported as one undifferentiated category, assigned to the transitional group by study convention, and re-examined in the sensitivity analyses of Section 2.7. The same logic applies to PDA: persistence beyond the physiological window could not be established retrospectively, so isolated PDA was assigned to the transitional group, with term-born PDA cases re-examined in the same analyses [7,8]. These analyses show how far the frequencies move under alternative assumptions; they do not establish the anatomical identity of any recorded lesion. The full classification protocol, with the criteria that were and were not available, is given in Supplementary Material S1.

Structural cases were additionally graded by the anatomic complexity dimension of the AHA/ACC classification of congenital heart disease (class I, simple; class II, moderate complexity; class III, great complexity) [18]. Grading used the most complex lesion present. Cases whose anatomy could not be graded from the available records, namely pulmonary artery stenosis without severity grading, unspecified Q20.8 lesions and isolated dextrocardia without documented intracardiac disease, were labeled "not gradable" rather than forced into a class. The term "critical CHD" is reserved for the duct-dependent or early-intervention lesions defined in the neonatal screening literature [19] and is not used as a synonym for class II–III disease. The lesion-by-lesion classification is given in Supplementary Table S4.

2.4. Antenatal Documentation

For every included neonate, the obstetric record held at the institution was searched for antenatally documented fetal anomalies. Four nested levels were defined: (i) any anomaly notation, cardiac or extracardiac; (ii) a cardiac-specific suspicion; (iii) a cardiac diagnosis concordant with the index lesion at birth, with additional lesions missed (partially concordant); and (iv) a fully concordant cardiac diagnosis. Because antenatal care was frequently received outside the institution and external reports were not systematically transferred, the completeness of antenatal records, gestational age at screening and fetal echocardiography utilization could not be established per pregnancy. The quantity reported here is therefore

documented antenatal recognition in available records, which bounds the true prenatal detection rate of the regional screening system from below; it is not an estimate of that rate. Each antenatal case is reported individually in Section 3.6.

2.5. Coding Audit

All 201 records were re-extracted from the source database, and every lesion field was cross-checked against the corresponding echocardiographic report text. The audit covered all diagnostic categories, not a selection. Its reproducible core is a term-level mapping table (Supplementary Table S2) listing the original Romanian diagnostic terminology, the code initially assigned during an earlier translation step, the corrected classification, and the number of affected records. The audit validates coding against the written report; it does not re-validate the underlying imaging interpretation, which was produced by a single reader and was not independently re-read (Section 4.5). Diagnostic-code validation of this kind is a recognized component of congenital anomaly data quality assessment [20].

2.6. Maternal Variables

Maternal sociodemographic data, obstetric history, chronic conditions, pregnancy-associated conditions and infections (including RT-PCR-confirmed SARS-CoV-2) were extracted from the electronic record and are reported descriptively in Section 3.7. No exposure–outcome association was tested. The largest exposure group contains five pregnancies, several contain one, no contemporaneous control group of unaffected births was assembled, and a screen across 26 or more exposure–outcome pairs at these counts cannot distinguish signal from multiplicity. Exposure frequencies are published for descriptive value and for future pooling; etiologic questions require the nested case–control design, drawing controls from the approximately 2700 unaffected births of the same period, that this cohort makes possible.

2.7. Statistical Analysis

The analysis is descriptive throughout. Continuous variables are summarized as median with range; categorical variables as counts with percentages and Wilson score 95% confidence intervals, which retain nominal coverage at small denominators [21]. Confidence intervals characterize the uncertainty of the observed institutional proportions; they are not estimates of population prevalence. For lesions absent from the cohort, the expected number of cases was computed per lesion as a Poisson expectation over 2909 births, with the assumed prevalence, expected count and zero-event probability reported explicitly (Section 3.5). Two sensitivity analyses bound the structural frequency: (a) A EUROCAT-aligned count adds the 23 term-born neonates whose findings included a PDA (20 isolated, 3 with an IAC), since EUROCAT excludes PDA only below 37 weeks; true secundum ASDs among the remaining 100 IACs cannot be identified and are represented by their expected number at a birth prevalence of 1 to 2 per 1000. (b) The extreme scenario assumes, in addition, that all 100 of these IACs are true secundum ASDs. Calculations were performed in Python 3.11 (Python Software Foundation, Wilmington, DE, USA); the analysis scripts reproduce every table and figure from the source database.

2.8. Ethics

The study was approved by the PBCCEH Research Committee (266/22.09.2021) and by the Ethics Committee of the "Victor Babes" University of Medicine and Pharmacy, Timisoara (47/01.09.2021), and complied with the Declaration of Helsinki and Regulation (EU) 2016/679. Informed consent for the use of anonymized data was obtained at admission according to institutional policy.

3. Results

3.1. Cohort and Group Assignment

Of 2909 live births, 201 neonates (6.9%; 95% CI 6.0–7.9) had an abnormal echocardiographic finding within 28 days of life. Maternal age had a median of 30 years (range 17 to 45). Sixty-six neonates (32.8% of findings; 2.27% of births, 95% CI 1.8–2.9) carried a structural defect; the remaining 135 (67.2% of findings; 4.64% of births) showed transitional findings alone: an isolated IAC in 99, an isolated PDA in 32, and the two together in 4. Prematurity separated the groups: 60 of 135 transitional-group infants were preterm (44.4%; 95% CI 36.3–52.9) against 13 of 66 in the structural group (19.7%; 95% CI 11.9–30.8), and within the transitional group 47 of 99 isolated IACs (47.5%) and 12 of 32 isolated PDAs (37.5%) occurred in preterm infants; three of the four neonates with an IAC and a PDA together were born at term. Sex distribution was balanced overall (101 girls, 50.2%) and within each group (structural, 32 girls and 34 boys; transitional, 69 girls and 66 boys). Figure 1 shows the cohort flow; Table 1 the characteristics by group.

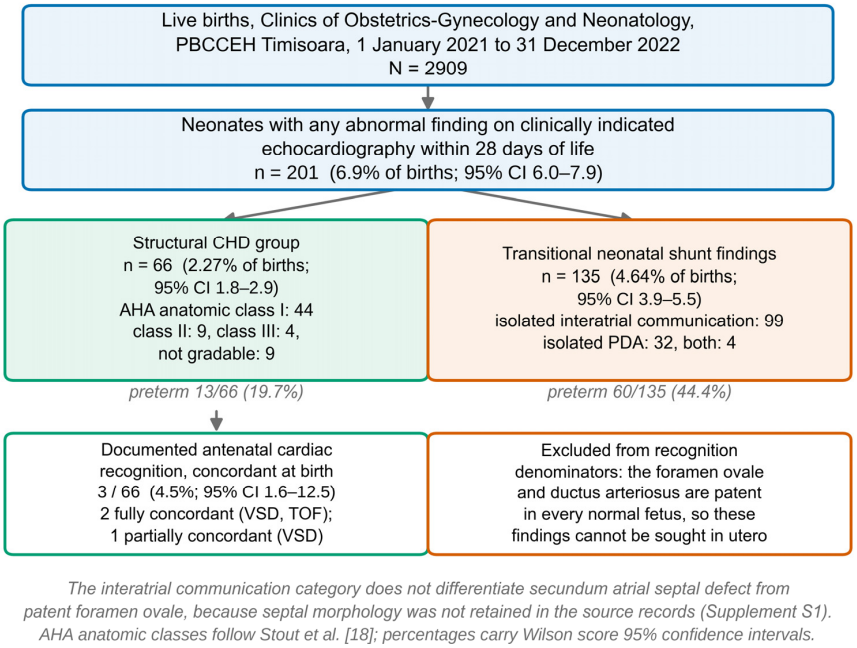

Figure 1. Cohort flow with the two-group case definition and American Heart Association (AHA) anatomic complexity grading of the structural group [18]. CHD, congenital heart defect; CI, confidence interval; PBCCEH, "Pius Brinzeu" County Clinical Emergency Hospital; PDA, patent ductus arteriosus; TOF, tetralogy of Fallot; VSD, ventricular septal defect.

Table 1. Neonatal characteristics, overall and by group.

Variable	All Findings (n = 201)	Structural CHD (n = 66)	Transitional Findings (n = 135)
Female sex, n (%)	101 (50.2)	32 (48.5)	69 (51.1)
Male sex, n (%)	100 (49.8)	34 (51.5)	66 (48.9)
Gestational age, weeks, median (range)	38 (25–41)	38 (27–41)	37 (25–41)
Preterm birth < 37 weeks, n (%; 95% CI)	73 (36.3; 30.0–43.2)	13 (19.7; 11.9–30.8)	60 (44.4; 36.3–52.9)
Birth weight, g, median (range)	2930 (600–5050)	3120 (1200–4500)	2750 (600–5050)
Apgar score at 1 min, median (range)	8 (1–10)	8 (4–10)	8 (1–10)

CHD, congenital heart defect; CI, Wilson score confidence interval.

3.2. Spectrum of Findings

Table 2 reports the data on two deliberately separated levels. The upper block lists all 22 mutually exclusive presentation patterns, which sum to 201, each with its group and AHA anatomic class, so that the class totals of Section 3.3 can be added up from the table; the lower block lists lesion-level frequencies, in which the 24 neonates (11.9%) carrying more than one lesion type appear once per lesion. The isolated IAC was the single most frequent pattern (99 of 201; 49.3%; 95% CI 42.4–56.1), followed by the isolated VSD and the isolated PDA (32 each; 15.9%). At lesion level, an IAC was present in 119 neonates (59.2%), a VSD in 48 (23.9%) and a PDA in 42 (20.9%). TOF occurred in 6 neonates (3.0%) and the remaining specified lesions in one case each. Figure 2 shows the pattern-level distribution.

Table 2. Echocardiographic findings: mutually exclusive presentation patterns (upper block) and lesion-level frequencies (lower block).

Finding	n	% of 201 (95% CI)	Group	AHA Class
Presentation patterns (mutually exclusive; sum = 201)				
Isolated interatrial communication (ASD/PFO undifferentiated)	99	49.3 (42.4–56.1)	T	n/a
Isolated ventricular septal defect	32	15.9 (11.5–21.6)	S	I
Isolated patent ductus arteriosus	32	15.9 (11.5–21.6)	T	n/a
VSD with IAC	8	4.0 (2.0–7.7)	S	I
Tetralogy of Fallot, isolated	4	2.0 (0.8–5.0)	S	II
IAC with PDA	4	2.0 (0.8–5.0)	T	n/a
VSD with IAC and PDA	3	1.5 (0.5–4.3)	S	I
Pulmonary artery stenosis, isolated	3	1.5 (0.5–4.3)	S	NG
Other Q20.8 lesion, isolated	3	1.5 (0.5–4.3)	S	NG
TOF with IAC	1	0.5 (0.1–2.8)	S	II
TOF with IAC and separately coded VSD	1	0.5 (0.1–2.8)	S	II
Ebstein anomaly	1	0.5 (0.1–2.8)	S	II
VSD with IAC and congenital mitral insufficiency	1	0.5 (0.1–2.8)	S	II
Aortopulmonary septal defect with IAC	1	0.5 (0.1–2.8)	S	II
Discordant AV connection with IAC and PDA	1	0.5 (0.1–2.8)	S	III
Hypoplastic left heart syndrome	1	0.5 (0.1–2.8)	S	III
TAPVC	1	0.5 (0.1–2.8)	S	III
Pulmonary atresia with Q20.8 lesion	1	0.5 (0.1–2.8)	S	III
VSD with PDA	1	0.5 (0.1–2.8)	S	I
Q20.8 lesion with VSD	1	0.5 (0.1–2.8)	S	NG
Q20.8 lesion with VSD, PDA and pulmonary artery stenosis	1	0.5 (0.1–2.8)	S	NG
Dextrocardia, isolated	1	0.5 (0.1–2.8)	S	NG
Lesion-level frequencies (a neonate may appear in several rows)				
Interatrial communication, any	119	59.2 (52.3–65.8)		
Ventricular septal defect, any	48	23.9 (18.5–30.2)		
Patent ductus arteriosus, any	42	20.9 (15.8–27.0)		
Tetralogy of Fallot	6	3.0 (1.4–6.4)		
Other Q20.8 lesion	6	3.0 (1.4–6.4)		
Pulmonary artery stenosis	4	2.0 (0.8–5.0)		
Single-lesion entities, one each: Ebstein anomaly, HLHS, pulmonary atresia, dextrocardia, TAPVC, discordant AV connection, congenital mitral insufficiency, aortopulmonary septal defect	8	0.5 (0.1–2.8) each		

AHA, American Heart Association; ASD, atrial septal defect; AV, atrioventricular; CI, Wilson score confidence interval; HLHS, hypoplastic left heart syndrome; IAC, interatrial communication; NG, not gradable; n/a, not applicable; PDA, patent ductus arteriosus; PFO, patent foramen ovale; S, structural; T, transitional; TAPVC, total anomalous pulmonary venous connection; TOF, tetralogy of Fallot; VSD, ventricular septal defect. AHA class follows the most complex lesion (Section 2.3). Class totals: I, 44; II, 9; III, 4; not gradable, 9.

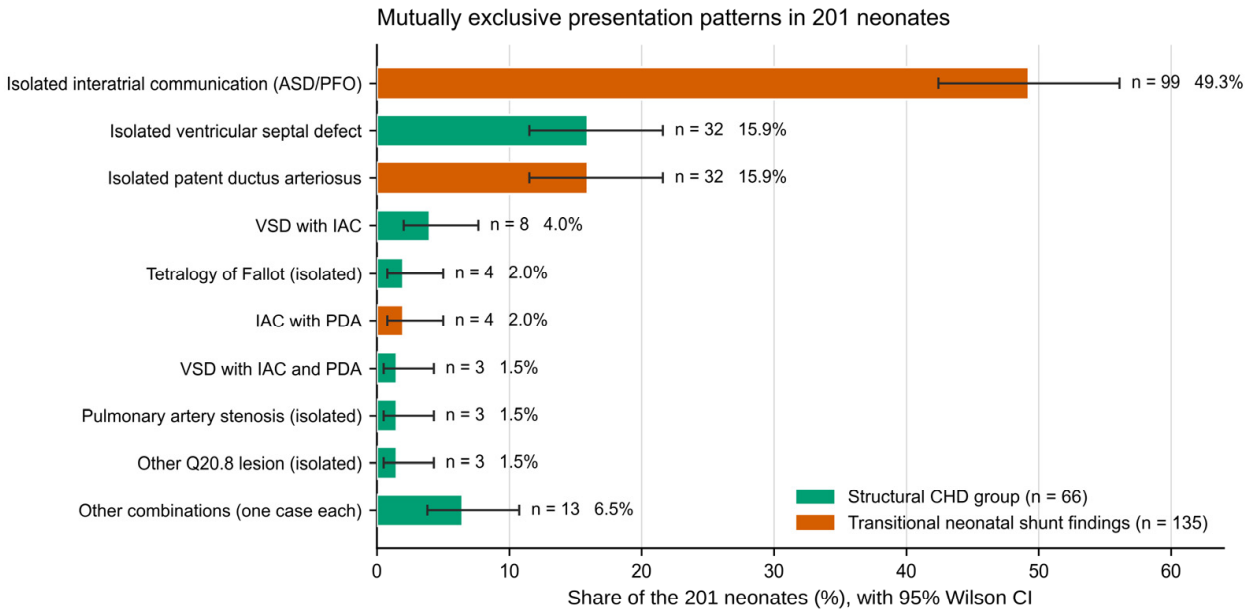

Figure 2. Mutually exclusive presentation patterns with Wilson score 95% confidence intervals, colored by group. ASD, atrial septal defect; CHD, congenital heart defect; CI, confidence interval; IAC, interatrial communication; PDA, patent ductus arteriosus; PFO, patent foramen ovale; TAPVC, total anomalous pulmonary venous connection; TOF, tetralogy of Fallot; VSD, ventricular septal defect.

3.3. Anatomic Complexity of the Structural Group

By the AHA anatomic dimension, 44 of 66 structural cases were class I, 9 class II, 4 class III, and 9 not gradable; every pattern carries its class in Table 2. Class I comprises the patterns in which a VSD was the most complex lesion: isolated VSD (32), VSD with IAC (8), VSD with IAC and PDA (3), and VSD with PDA (1). The other 4 of the 48 VSD-containing neonates were graded by a co-lesion: one TOF with IAC and a separately coded VSD and one VSD with IAC and congenital mitral insufficiency (class II), and two patterns containing an unspecified Q20.8 lesion (not gradable). Class II comprises the six TOF cases (four isolated, two with an IAC), the Ebstein anomaly, the VSD with mitral insufficiency and the aortopulmonary septal defect with IAC. Class III comprises discordant atrioventricular connection, HLHS, total anomalous pulmonary venous connection and pulmonary atresia, the last coded together with a Q20.8 lesion. The nine not gradable cases are three isolated pulmonary artery stenoses without severity grading, five patterns containing unspecified Q20.8 lesions (three isolated, one with a VSD, one with a VSD, PDA and pulmonary artery stenosis) and one isolated dextrocardia, which we do not treat as severe disease without documented intracardiac involvement. The lesion-level counts of Table 2 therefore reconcile as follows: the six Q20.8 lesions are five not gradable patterns plus the pulmonary atresia, and the four pulmonary artery stenoses are three isolated plus one in a Q20.8 combination. Class II–III disease together amounted to 13 cases, 4.5 per 1000 births (95% CI 2.6–7.6). Table 3 summarizes the classes with their documented antenatal recognition; Supplementary Table S4 gives the rationale for each "not gradable" label. Severity grading in the hemodynamic sense, and neonatal interventions, could not be assessed (Section 3.8).

Table 3. AHA anatomic complexity of the 66 structural cases and documented antenatal recognition by class.

AHA Anatomic Class	Composition	n	Documented Recognition, n/N (%; 95% CI)
Class I (simple)	VSD-based patterns (isolated, or with IAC and/or PDA)	44	2/44 (4.5; 1.3–15.1)
Class II (moderate)	TOF (6), Ebstein anomaly, VSD + IAC + mitral insufficiency, aortopulmonary septal defect + IAC	9	1/9 (11.1; 2.0–43.5)
Class III (great complexity)	Discordant AV connection, HLHS, TAPVC, pulmonary atresia	4	0/4 (0; 0–49.0)
Not gradable	Pulmonary artery stenosis without severity grade (3), patterns with unspecified Q20.8 lesions (5), isolated dextrocardia (1)	9	0/9 (0; 0–29.9)
Class II–III combined		13	1/13 (7.7; 1.4–33.3)

ACC, American College of Cardiology; AHA, American Heart Association; AV, atrioventricular; CI, Wilson score confidence interval; HLHS, hypoplastic left heart syndrome; IAC, interatrial communication; PDA, patent ductus arteriosus; TAPVC, total anomalous pulmonary venous connection; TOF, tetralogy of Fallot; VSD, ventricular septal defect. Classes follow the anatomic dimension of the AHA/ACC classification; grading used the most complex lesion per case. Recognition means a documented antenatal cardiac diagnosis concordant with the index lesion at birth.

3.4. Sensitivity of the Structural Frequency to Classification Assumptions

The primary structural group is narrower than the EUROCAT case definition (Section 2.3), so the 2.27% is not a registry-comparable figure and is not set against the EUROCAT total CHD prevalence of 8.0 per 1000. Applying the EUROCAT rules as far as the records allow, the 23 term-born neonates whose findings included a PDA enter the count, giving 3.06% (89/2909; 95% CI 2.49–3.75). True secundum ASDs among the remaining 100 IACs would add to this but cannot be identified; at a birth prevalence of 1 to 2 per 1000, about 3 to 6 are expected, which gives roughly 3.2% to 3.3%. Under the extreme assumption that all 100 are true secundum ASDs, the frequency would reach 6.50% (189/2909; 95% CI 5.66–7.45). These bounds show what the classification assumptions do to the count; they do not establish the anatomy of any individual lesion. Even the EUROCAT-aligned figure is a hospital frequency, produced by indication-driven echocardiography in a referral unit, with no size threshold for VSDs (44 of 66 structural cases are VSD-based class I patterns) and with possible exit of prenatally diagnosed severe cases before delivery; it is not a population prevalence. The class II–III frequency (4.5 per 1000; Section 3.3) is the quantity least affected by these choices. It can be set beside the EUROCAT severe CHD figure of 2.0 per 1000 [3] only approximately, because the two groupings are not defined identically.

3.5. Absence of Recorded Coarctation, Valvar Aortic Stenosis, and Interrupted Aortic Arch

No coarctation of the aorta, valvar aortic stenosis or interrupted aortic arch was recorded within the neonatal window; one HLHS case was present, so left-sided obstructive disease as a category was not absent. The quantified part of the explanation is statistical expectation, computed per lesion (Table 4): at registry prevalence, 2909 births predict about one coarctation case, and the Poisson probability of observing none is 0.35; for valvar aortic stenosis and interrupted aortic arch the expected counts are 0.58 and 0.18, with probabilities of observing none of 0.56 and 0.83. Two further mechanisms are plausible but unquantified in this cohort, and we state them as inference, not evidence: pregnancies with suspected duct-dependent lesions are redirected for delivery near the national pediatric cardiac surgery center, and coarctation classically presents at or after ductal closure, often after discharge from the maternity unit, so a 28-day maternity window is structurally blind

to part of this lesion group [22]. The single antenatal coarctation suspicion in this series was not confirmed postnatally (Table 5).

Table 4. Zero-event expectation for left-sided obstructive lesions, per lesion.

Lesion	Assumed Prevalence (per 10,000 Births)	Expected Cases in 2909 Births	Poisson P (0 Cases)
Coarctation of the aorta	3.6 [3]	1.05	0.35
Valvar aortic stenosis	2.0 [1,3]	0.58	0.56
Interrupted aortic arch	0.62 [23]	0.18	0.83

Expectations are computed lesion by lesion, not for the combined category, as Poisson expectations over 2909 births at the assumed prevalence.

Table 5. All antenatally documented anomaly notations and their postnatal correlates.

Antenatal Notation	GA at Antenatal Examination, Weeks	GA at Birth, Weeks	Postnatal Echocardiogram	Classification
Muscular VSD	not recorded	38	VSD	Fully concordant
VSD	not recorded	38	VSD with IAC and PDA	Partially concordant (co-lesions missed)
Tetralogy of Fallot	not recorded	39	Tetralogy of Fallot	Fully concordant
Coarctation suspicion	29	37	Isolated IAC	Not confirmed
Trisomy 13 suspicion	20	38	PDA	No cardiac suspicion recorded
Ventriculomegaly	23	27	VSD with IAC and mitral insufficiency	Extracardiac notation; cardiac lesions unrecognized
Cerebral malformation	29	36	VSD	Extracardiac notation; cardiac lesion unrecognized

GA, gestational age; IAC, interatrial communication; PDA, patent ductus arteriosus; VSD, ventricular septal defect. Gestational age at the antenatal examination is reported where the obstetric record preserved it.

3.6. Documented Antenatal Recognition

Seven of the 201 pregnancies (3.5%; 95% CI 1.7–7.0) carried an antenatally documented anomaly notation in the records available at the institution. A cardiac-specific suspicion existed in four (2.0%), and in three the suspicion was concordant with the index cardiac lesion at birth: two fully concordant (one muscular VSD; one TOF) and one partially concordant (VSD confirmed, with an IAC and a PDA additionally found postnatally). Documented recognition was therefore 3 of 66 structural cases (4.5%; 95% CI 1.6–12.5), 2 of 66 if restricted to fully concordant diagnoses (3.0%; 95% CI 0.8–10.4), and 1 of 13 class II–III cases (7.7%; 95% CI 1.4–33.3). Each antenatal case is itemized in Table 5, including the two extracardiac notations whose cardiac lesions went unremarked and the coarctation suspicion that dissolved postnatally. Figure 3 places these figures in context. Two caveats bound the interpretation: transitional findings cannot enter any recognition denominator, because the corresponding fetal structures are patent in every normal fetus; and the available records understate whatever scanning took place outside the institution, so these figures bound the true regional detection rate from below (Section 2.4).

3.7. Maternal Conditions (Descriptive Only)

Documented maternal conditions were infrequent: urinary tract infection, gestational hypertension, gestational diabetes and RT-PCR-confirmed SARS-CoV-2 infection in five pregnancies each (2.5%), heterozygous Factor V Leiden thrombophilia in four (2.0%), and a series of single occurrences (Table 6). Two database entries, Down syndrome and Klinefelter syndrome, appear in maternal-history fields but could not be verified as maternal rather

than fetal diagnoses; they are classified as unresolved and excluded from the maternal condition count. No association testing was performed (Section 2.6).

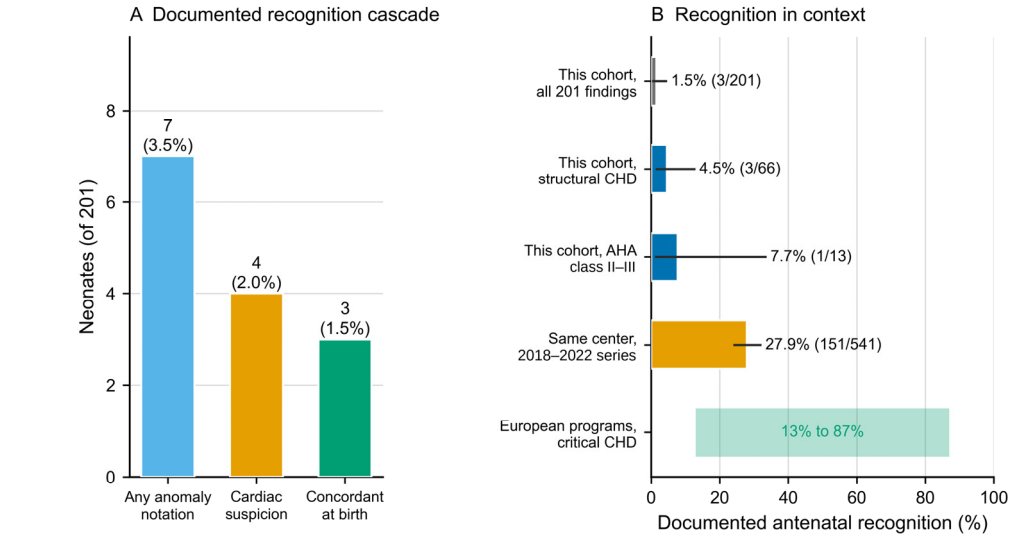

Figure 3. Documented antenatal recognition: cascade (**A**) and context (**B**). AHA, American Heart Association; CHD, congenital heart defect.

Table 6. Maternal conditions documented in the 201 pregnancies.

Condition	n	% of 201
Urinary tract infection	5	2.5
Gestational hypertension	5	2.5
Gestational diabetes mellitus	5	2.5
SARS-CoV-2 infection (RT-PCR confirmed)	5	2.5
Thrombophilia (heterozygous Factor V Leiden)	4	2.0
Anemia	3	1.5
Primary arterial hypertension	3	1.5
In vitro fertilization	2	1.0
One occurrence each: thrombocytopenia, hypothyroidism, toxoplasmosis, influenza, varicella, Enterobacter infection, hepatitis B carriage, acute renal failure, surgical single kidney, splenectomy, placenta previa, Klippel–Trenaunay syndrome, severe disability	1 each	0.5 each
Unresolved entries (maternal versus fetal attribution not verifiable): Down syndrome, Klinefelter syndrome	1 each	excluded from maternal counts

No inferential statistics were computed for this table.

3.8. Data Availability Constraints

Three descriptive questions raised during review could not be answered from the research extraction, and we state this explicitly rather than by omission. First, neonatal interventions: transfer for cardiac surgery, catheter-based intervention, or specialized cardiac management during the neonatal period were not consistently coded in the source database, so the immediate clinical consequences of the diagnostic spectrum cannot be reported. Second, temporal distribution: the research extraction, built to de-identify patients, did not retain the calendar date of birth, so counts cannot be split between 2021 and 2022. Third,

echocardiographic indications: the indication for each examination (murmur, respiratory compromise, prematurity protocol, extracardiac anomaly, antenatal suspicion) was not a structured field. All three are design targets for the prospective successor study (Section 5) and are carried as limitations in Section 4.5.

4. Discussion

Three results organize the interpretation: the composition of the case mix once structural disease is separated from transitional findings and graded; the scarcity of documented antenatal recognition; and a coding audit that removed a spurious cluster of a rare malformation. None of them is etiologic.

4.1. What the Case Mix Contains and Why the Frequency Exceeds Registry Prevalence

Two-thirds of the neonates labeled as having a heart defect had only an isolated IAC, an isolated PDA, or both, and nearly half of that group was preterm, in whom these findings are expected physiology [5–8]. This is the signature of indication-driven echocardiography in a unit that concentrates preterm and complicated deliveries, and it accounts for most of the distance between the 6.9% headline figure and registry prevalence [1–4,9]. Because the primary structural group is narrower than the EUROCAT definition, a comparison with registries has to rest on the EUROCAT-aligned count or, more safely, on the class II–III frequency (Section 3.4). Pattern-level counts, lesion-level counts, complexity grades and sensitivity bounds answer different questions, and no single headline percentage answers them all.

4.2. The Recognition Gap

Documented antenatal recognition was 4.5% of structural cases, 3.0% under the fully concordant definition, and one of thirteen class II–III cases. European programs achieve 13% to 87% for critical defects depending on screening organization [24], and national screening in the Netherlands raised detection of severe CHD from 35.8% to 59.7% [25]. The earlier series from this center reported 28% [15]; the two figures are not comparable, and the gap is neither a trend nor an effect of definition alone. The earlier figure related any antenatal cardiac observation to all 541 CHD labels, interatrial and ductal findings included, although those cannot be diagnosed before birth. Applied to the present records, the same permissive rule gives 4 of 201 (2.0%), or 7 of 201 (3.5%) if extracardiac notations are counted. The difference therefore implies either antenatal information that is not in the records available to this study or a different rate in 2018–2020; the earlier numerator cannot be reconstructed from the present extraction (Supplementary Table S3). The present figure is a lower bound: concordance with the birth diagnosis is required, and prenatal–postnatal discordance is substantial even in specialized centers [26]; septal defects, the lesions least visible at screening gestations, dominate the denominator [25,27]; and scans performed elsewhere and not transferred are invisible here. Two fetuses carried extracardiac anomaly notations while their cardiac lesions went unremarked, and the one coarctation suspicion was not confirmed (Table 5), consistent with the guidance that any fetal anomaly suspicion should prompt fetal echocardiography [27,28].

4.3. Zero Recorded Events as Data

The absence of recorded coarctation, valvar aortic stenosis and interrupted aortic arch is consistent with expectation at 2909 births (Table 4). Prenatal redirection and post-discharge presentation at ductal closure [22] remain unmeasured inferences, which follow-up linkage to pediatric cardiology records would turn into measurements.

4.4. Why No Etiologic Inference Is Offered

The exposure data cannot support etiologic analysis: each exposure of interest, SARS-CoV-2 infection included, involves at most five pregnancies, there is no contemporaneous control group, and established maternal risk factors for CHD rest on population-scale designs [10,11,29,30], as do pandemic-cohort claims [12,13]. The series contributes descriptive exposure frequencies for pooling (Table 6) and a sampling frame for a nested case–control study. Apgar scores were not analyzed against defect type, because large septal shunts become hemodynamically significant only as pulmonary vascular resistance falls over days to weeks [31].

4.5. Strengths and Limitations

The strengths are completeness within the stated frame (every live birth of the period), individual-level reporting of every presentation pattern and antenatal case, a prespecified conservative case definition whose distance from the EUROCAT definition is quantified, complexity grading by a published classification, and a reproducible coding audit (Supplementary Material S1 and Supplementary Tables S2 and S4).

Ascertainment was indication-driven, the indication mix was unrecorded and the number of neonates examined was unknown, so the frequencies are minimum hospital frequencies, not prevalence. The IAC category cannot separate secundum ASD from PFO and ductal persistence could not be established; the primary structural group is therefore narrower than the EUROCAT definition, and the EUROCAT-aligned count is bounded rather than measured. A single reader reported all echocardiograms, and the audit validated codes against reports, not images. External antenatal documentation was not systematically available. Neonatal interventions, calendar year of birth and examination indications were not retained (Section 3.8). The 28-day window misses later presentations, coarctation foremost [22], and terminations and stillbirths were not captured. Finally, the cohort overlaps the 2021–2022 portion of the earlier 2018–2022 series; Supplementary Table S3 itemizes the shared period, variables and definitions, and the points at which the two denominators and detection figures cannot be reconciled.

5. Conclusions

In a regional referral maternity in Western Romania during 2021 and 2022, two-thirds of neonates recorded as having a congenital heart defect carried only what this study conservatively classed as transitional findings of the newborn circulation, and the structural minority was rarely recognized before birth in available records: three concordant antenatal diagnoses among 66 structural cases; one among thirteen cases of moderate or great anatomic complexity. A full coding audit removed a spurious cluster of 36 aortopulmonary communications created by a translation step. The conclusions this design supports are procedural. Institutional cardiac series should publish tiered case definitions stated against registry rules, anatomic complexity grades, sensitivity bounds and coding audits alongside their counts. Strengthening structured referral pathways to fetal echocardiography is proposed as a quality-improvement priority for the region, not as a demonstrated superior intervention; whether structured referral, standardized screening criteria or sonographer training yields the greatest gain in prenatal recognition is the question for a prospective study with protocolized antenatal documentation, outcome capture, and per-year reporting. Etiologic questions about pandemic-era exposures remain outside what this cohort can answer and belong to the nested case–control design for which it provides the sampling frame.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/children13121623/s1, Supplementary Material S1: Classification

protocol and available echocardiographic criteria; Table S1. AHA anatomic complexity class assigned by the most complex lesion present in each case; Table S2: Coding audit mapping (original Romanian terminology, initial code, corrected classification, affected records); Table S3: Overlap and differentiation with the previously published 2018–2022 series; Table S4: Lesion-by-lesion anatomic classification with documented antenatal recognition.

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Informed Consent Statement: Informed consent for the use of anonymized medical data was obtained from all subjects or their legal representatives.

Data Availability Statement: The data supporting this study are available from the corresponding author on reasonable request, subject to confidentiality regulations. The extraction and analysis scripts that reproduce all tables and figures are provided with the submission.

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Abbreviations

The following abbreviations are used in this manuscript:

AHA	American Heart Association
ACC	American College of Cardiology
ASD	Atrial septal defect
AV	Atrioventricular
CHD	Congenital heart defect
CI	Confidence interval
GA	Gestational age
HLHS	Hypoplastic left heart syndrome
IAC	Interatrial communication
ICD-10	International Classification of Diseases, 10th Revision
PBCCEH	"Pius Brinzeu" County Clinical Emergency Hospital
PDA	Patent ductus arteriosus
PFO	Patent foramen ovale
RT-PCR	Reverse transcription polymerase chain reaction
STROBE	Strengthening the Reporting of Observational Studies in Epidemiology
TAPVC	Total anomalous pulmonary venous connection
TOF	Tetralogy of Fallot
VSD	Ventricular septal defect

References

1. van der Linde, D.; Konings, E.E.M.; Slager, M.A.; Witsenburg, M.; Helbing, W.A.; Takkenberg, J.J.M.; Roos-Hesselink, J.W. Birth prevalence of congenital heart disease worldwide: A systematic review and meta-analysis. *J. Am. Coll. Cardiol.* **2011**, *58*, 2241–2247. [CrossRef] [PubMed]
2. Liu, Y.; Chen, S.; Zühlke, L.; Black, G.C.; Choy, M.-K.; Li, N.; Keavney, B.D. Global birth prevalence of congenital heart defects 1970–2017: Updated systematic review and meta-analysis of 260 studies. *Int. J. Epidemiol.* **2019**, *48*, 455–463. [CrossRef] [PubMed]

3. Dolk, H.; Loane, M.; Garne, E.; European Surveillance of Congenital Anomalies (EUROCAT) Working Group. Congenital heart defects in Europe: Prevalence and perinatal mortality, 2000 to 2005. *Circulation* **2011**, *123*, 841–849. [CrossRef] [PubMed]
4. Hoffman, J.I.E.; Kaplan, S. The incidence of congenital heart disease. *J. Am. Coll. Cardiol.* **2002**, *39*, 1890–1900. [CrossRef] [PubMed]
5. Hagen, P.T.; Scholz, D.G.; Edwards, W.D. Incidence and size of patent foramen ovale during the first 10 decades of life: An autopsy study of 965 normal hearts. *Mayo Clin. Proc.* **1984**, *59*, 17–20. [CrossRef] [PubMed]
6. Radzik, D.; Davignon, A.; van Doesburg, N.; Fournier, A.; Marchand, T.; Ducharme, G. Predictive factors for spontaneous closure of atrial septal defects diagnosed in the first 3 months of life. *J. Am. Coll. Cardiol.* **1993**, *22*, 851–853. [CrossRef] [PubMed]
7. Benitz, W.E.; Committee on Fetus and Newborn, American Academy of Pediatrics. Patent ductus arteriosus in preterm infants. *Pediatrics* **2016**, *137*, e20153730. [CrossRef] [PubMed]
8. Semberova, J.; Sirc, J.; Miletin, J.; Kucera, J.; Berka, I.; Sebkova, S.; O'Sullivan, S.; Franklin, O.; Stranak, Z. Spontaneous closure of patent ductus arteriosus in infants ≤1500 g. *Pediatrics* **2017**, *140*, e20164258. [CrossRef] [PubMed]
9. EUROCAT. *EUROCAT Guide 1.4: Instruction for the Registration of Congenital Anomalies*; EUROCAT Central Registry, University of Ulster: Newtownabbey, UK, 2013.
10. Jenkins, K.J.; Correa, A.; Feinstein, J.A.; Botto, L.; Britt, A.E.; Daniels, S.R.; Elixson, M.; Warnes, C.A.; Webb, C.L. Noninherited risk factors and congenital cardiovascular defects: Current knowledge. A scientific statement from the American Heart Association Council on Cardiovascular Disease in the Young. *Circulation* **2007**, *115*, 2995–3014. [CrossRef] [PubMed]
11. Botto, L.D.; Lin, A.E.; Riehle-Colarusso, T.; Malik, S.; Correa, A. Seeking causes: Classifying and evaluating congenital heart defects in etiologic studies. *Birth Defects Res. A Clin. Mol. Teratol.* **2007**, *79*, 714–727. [CrossRef] [PubMed]
12. Ren, H.; Zhang, X.; Zhang, S.; Pan, J.; Wang, W. The association of increased incidence of congenital heart disease in newborns with maternal COVID-19 infection during pregnancy. *Sci. Rep.* **2024**, *14*, 24866. [CrossRef] [PubMed]
13. Khalil, A.; Painter, I.; Souter, V. Congenital heart defects during COVID-19 pandemic. *Ultrasound Obstet. Gynecol.* **2025**, *65*, 546–551. [CrossRef] [PubMed]
14. Craina, M.; Iacob, D.; Dima, M.; Bernad, S.; Silaghi, C.; Moza, A.; Pantea, M.; Gluhovschi, A.; Bernad, E. Clinical, laboratory, and imaging findings of pregnant women with possible vertical transmission of SARS-CoV-2: Case series. *Int. J. Environ. Res. Public Health* **2022**, *19*, 10916. [CrossRef] [PubMed]
15. Ciulpan, A.; Lacatusu, A.; Pop, L.L.; Paul, C.; Lungeanu, D.; Iacob, D.; Bernad, B.-C.; Lascu, A.; Maghet, E.; Arnautu, D.-A.; et al. Incidence and antenatal detection of congenital heart malformations: Data from a tertiary obstetric Romanian center. *Diagnostics* **2024**, *14*, 1659. [CrossRef] [PubMed]
16. von Elm, E.; Altman, D.G.; Egger, M.; Pocock, S.J.; Gøtzsche, P.C.; Vandenbroucke, J.P.; STROBE Initiative. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: Guidelines for reporting observational studies. *Lancet* **2007**, *370*, 1453–1457. [CrossRef] [PubMed]
17. Ferencz, C.; Rubin, J.D.; Loffredo, C.A.; Magee, C.A. *Epidemiology of Congenital Heart Disease: The Baltimore-Washington Infant Study 1981–1989*; Futura Publishing: Mount Kisco, NY, USA, 1993.
18. Stout, K.K.; Daniels, C.J.; Aboulhosn, J.A.; Bozkurt, B.; Broberg, C.S.; Colman, J.M.; Crumb, S.R.; Dearani, J.A.; Fuller, S.; Gurvitz, M.; et al. 2018 AHA/ACC guideline for the management of adults with congenital heart disease: A report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *Circulation* **2019**, *139*, e698–e800. [CrossRef] [PubMed]
19. Mahle, W.T.; Newburger, J.W.; Matherne, G.P.; Smith, F.C.; Hoke, T.R.; Koppel, R.; Gidding, S.S.; Beekman, R.H., 3rd; Grosse, S.D. Role of pulse oximetry in examining newborns for congenital heart disease: A scientific statement from the AHA and AAP. *Circulation* **2009**, *120*, 447–458. [CrossRef] [PubMed]
20. Loane, M.; Dolk, H.; Garne, E.; Greenlees, R.; EUROCAT Working Group. Paper 3: EUROCAT data quality indicators for population-based registries of congenital anomalies. *Birth Defects Res. A Clin. Mol. Teratol.* **2011**, *91*, S23–S30. [CrossRef] [PubMed]
21. Newcombe, R.G. Two-sided confidence intervals for the single proportion: Comparison of seven methods. *Stat. Med.* **1998**, *17*, 857–872. [CrossRef]
22. Wren, C.; Reinhardt, Z.; Khawaja, K. Twenty-year trends in diagnosis of life-threatening neonatal cardiovascular malformations. *Arch. Dis. Child. Fetal Neonatal Ed.* **2008**, *93*, F33–F35. [CrossRef] [PubMed]
23. Mai, C.T.; Isenburg, J.L.; Canfield, M.A.; Meyer, R.E.; Correa, A.; Alverson, C.J.; Lupo, P.J.; Riehle-Colarusso, T.; Cho, S.J.; Aggarwal, D.; et al. National population-based estimates for major birth defects, 2010–2014. *Birth Defects Res.* **2019**, *111*, 1420–1435. [CrossRef] [PubMed]
24. Bakker, M.K.; Bergman, J.E.H.; Krikov, S.; Amar, E.; Cocchi, G.; Cragan, J.; de Walle, H.E.K.; Gatt, M.; Groisman, B.; Liu, S.; et al. Prenatal diagnosis and prevalence of critical congenital heart defects: An international retrospective cohort study. *BMJ Open* **2019**, *9*, e028139. [CrossRef] [PubMed]

25. van Velzen, C.L.; Clur, S.A.; Rijlaarsdam, M.E.B.; Bax, C.J.; Pajkrt, E.; Heymans, M.W.; Bekker, M.N.; Hruda, J.; de Groot, C.J.M.; Blom, N.A.; et al. Prenatal detection of congenital heart disease: Results of a national screening programme. *BJOG* **2016**, *123*, 400–407. [CrossRef] [PubMed]
26. van Velzen, C.L.; Clur, S.A.; Rijlaarsdam, M.E.B.; Pajkrt, E.; Bax, C.J.; Hruda, J.; de Groot, C.J.M.; Blom, N.A.; Haak, M.C. Prenatal diagnosis of congenital heart defects: Accuracy and discrepancies in a multicenter cohort. *Ultrasound Obstet. Gynecol.* **2016**, *47*, 616–622. [CrossRef] [PubMed]
27. Carvalho, J.S.; Axt-Fliedner, R.; Chaoui, R.; Copel, J.A.; Cuneo, B.F.; Goff, D.; Gordin Kopylov, L.; Hecher, K.; Lee, W.; Moon-Grady, A.J.; et al. ISUOG Practice Guidelines (updated): Fetal cardiac screening. *Ultrasound Obstet. Gynecol.* **2023**, *61*, 788–803. [CrossRef] [PubMed]
28. Donofrio, M.T.; Moon-Grady, A.J.; Hornberger, L.K.; Copel, J.A.; Sklansky, M.S.; Abuhamad, A.; Cuneo, B.F.; Huhta, J.C.; Jonas, R.A.; Krishnan, A.; et al. Diagnosis and treatment of fetal cardiac disease: A scientific statement from the American Heart Association. *Circulation* **2014**, *129*, 2183–2242. [CrossRef] [PubMed]
29. Øyen, N.; Diaz, L.J.; Leirgul, E.; Boyd, H.A.; Priest, J.; Mathiesen, E.R.; Quertermous, T.; Wohlfahrt, J.; Melbye, M. Prepregnancy diabetes and offspring risk of congenital heart disease: A nationwide cohort study. *Circulation* **2016**, *133*, 2243–2253. [CrossRef] [PubMed]
30. Ramakrishnan, A.; Lee, L.J.; Mitchell, L.E.; Agopian, A.J. Maternal hypertension during pregnancy and the risk of congenital heart defects in offspring: A systematic review and meta-analysis. *Pediatr. Cardiol.* **2015**, *36*, 1442–1451. [CrossRef] [PubMed]
31. Rudolph, A.M. The changes in the circulation after birth: Their importance in congenital heart disease. *Circulation* **1970**, *41*, 343–359. [CrossRef] [PubMed]

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