Type of the Paper (Systematic Review)

Prevalence of Complex Congenital Heart Diseases in Neonates in Fayoum Governorate: A Systematic Review

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Abstract:

Introduction: Congenital heart disease is defined as a complex birth condition exhibiting general features across children within various geographical regions.

Aim of the study: To determine the frequency of complex congenital heart diseases in neonates in Fayoum governorate.

Methods: Two authors conducted an independent search of online databases, involving EMBASE, PubMed, MEDLINE, Scopus, Cochrane Library, and Web of Science, utilizing a combination of MeSH and text keywords such as 'congenital heart disease', 'heart abnormality', 'congenital heart defect', 'occurrence', 'frequency', 'heart malformation', 'epidemiology', 'frequency', and 'neonates'. This research involved investigations examining the occurrence of CHD between cases aged from birth to twelve years. Initially, our selection criteria focused on research examining the occurrence of congenital heart disease at birth. Upon a thorough review, most of this research focused on the age category of zero to one years, except for a single study that included a wider age range of zero to twelve years. Research design: cross-sectional and cohort research.

Results: The occurrence of congenital heart disease was the consequence. The prevalence of CHD was relatively elevated. Atrial septal and ventricular abnormalities had the highest prevalence, with a greater incidence in male neonates than in female infants. The enhancement of diagnostic facilities in various areas significantly impacts the reduction of these anomalies.

Conclusions: The prevalence of CHD was relatively elevated, with Atrial septal and ventricular abnormalities having the highest prevalence, with a greater incidence in male neonates than in female infants.

Keywords: Prevalence; congenital; heart disease; neonates.

1. Introduction

Congenital heart defects (CHD) are among the most common congenital abnormalities, accounting for approximately 28% of all birth defects [1]. CHD refers to structural malformations of the heart or great vessels that develop during intrauterine growth, regardless of the age at presentation. It is defined as a "gross structural abnormality of the heart or intrathoracic great vessels with potential or actual functional significance" [2]. The global birth prevalence of CHD is estimated at 8–12 per 1,000 live births, with a median rate of 9 per 1,000 live births, translating to approximately 1.35 million affected infants annually [3]. When including minor anomalies, the incidence increases to 75 per 1,000 live births [4].

CHD is a leading cause of morbidity and mortality, particularly in the first year of life. While most cases present as isolated cardiac anomalies, over 30% are associated with defects in other organs or systems [5]. Estimating the true prevalence is challenging due to variability across populations and registries, as mild or asymptomatic cases often go undiagnosed, and severe cases may result in neonatal mortality before diagnosis. Advances in prenatal screening and echocardiography have improved detection rates, particularly for minor lesions like small atrial septal defects (ASDs) and ventricular septal defects (VSDs), which often resolve spontaneously, thereby increasing overall prevalence estimates [6, 7].

CHD significantly impacts patients' quality of life, imposes financial burdens on families and healthcare systems, and often requires lifelong monitoring and multiple interventions [8]. While advancements in evidence-based medicine and early interventions have improved outcomes in high-income countries, disparities remain in low- and middle-income settings, where access to advanced care is limited [3].

This systematic review aims to evaluate the prevalence and complexity of congenital heart defects in neonates within the Fayoum governorate, addressing gaps in knowledge specific to this population.

2. Methods

2.1. Search Strategy

Two authors conducted an independent search of online databases, involving EMBASE, PubMed, MEDLINE, Scopus, Cochrane Library, and Web of Science, utilizing a combination of MeSH and text keywords such as ‘CHD, 'congenital heart disease', ‘heart malformation', 'heart abnormality’, 'epidemiology',' frequency ', ‘occurrence, and 'neonates'. The electronic searches have been restricted to investigations published in English and involving human subjects. Ethical approval was obtained before the start. Furthermore, we performed a manual examination of the reference lists from the involved clinical trials & prior reviews to identify supplementary investigations.

2.2. PICO criteria

Population

This research involved investigations examining the occurrence of CHD between cases aged from birth to twelve years.

Intervention

Speckle tracking imaging.

Comparison

None.

Outcomes

Congenital heart disease.

2.3. Inclusion and exclusion criteria

Inclusion criteria

Initially, our selection criteria highlighted research examining the occurrence of congenital heart disorders at birth. Upon thorough evaluation, most of this research focused on the age category of zero to one years, except for a single investigation that included a wider age range of zero to twelve years. The current research has been included for its unique insights into the regional patterns of congenital heart disorder occurrence at birth. Research design: cross-sectional & cohort research. Language: Research published in the English language. The prevalence of coronary heart disease was the consequence.

Exclusion criteria

Investigations, including reviews, books, or comments [2]. Investigations

assessing the frequency of congenital heart disease in specific communities, including individuals with Down syndrome, among others [3]. Investigations that exclusively reported the congenital heart disorder occurrence in schoolchildren & adults, excluding the occurrence at birth, have been excluded.

2.4. Study selection

Both the entire full-text and abstracts underwent conventional, blind review. Selected publications' references to pertinent studies were reviewed for potential inclusion. The Excel program was utilized. Moreover, any differences among scholars were settled by senior contributors before final clearance.

2.5. Data extraction

Two writers performed the information extraction independently. The collected information involved the author's name, publication year, location of research, research kind, age, sample size, gender, and the prevalence of CHD. To maintain reliability and consistency, both reviewers operated independently during the extraction procedure, and any differences have been resolved by consensus & discussion.

2.6. *Bias risk assessment, quality, and validity of included studies*

The author evaluated the included studies for quality and bias risk, including using the Newcastle-Ottawa Scale.

3. Results

3.1. Research selection and search results

Figure 1 illustrates a PRISMA diagram. A total of 210 records have been determined. 20 of the 210 records had been deleted by title and abstract, and the following duplicates were removed. The eligibility of ten full-text articles was evaluated. Two of the four did not satisfy the inclusion criteria (the number=2): Wrong population; (the number=2). The other six papers from the ten investigations were eligible.

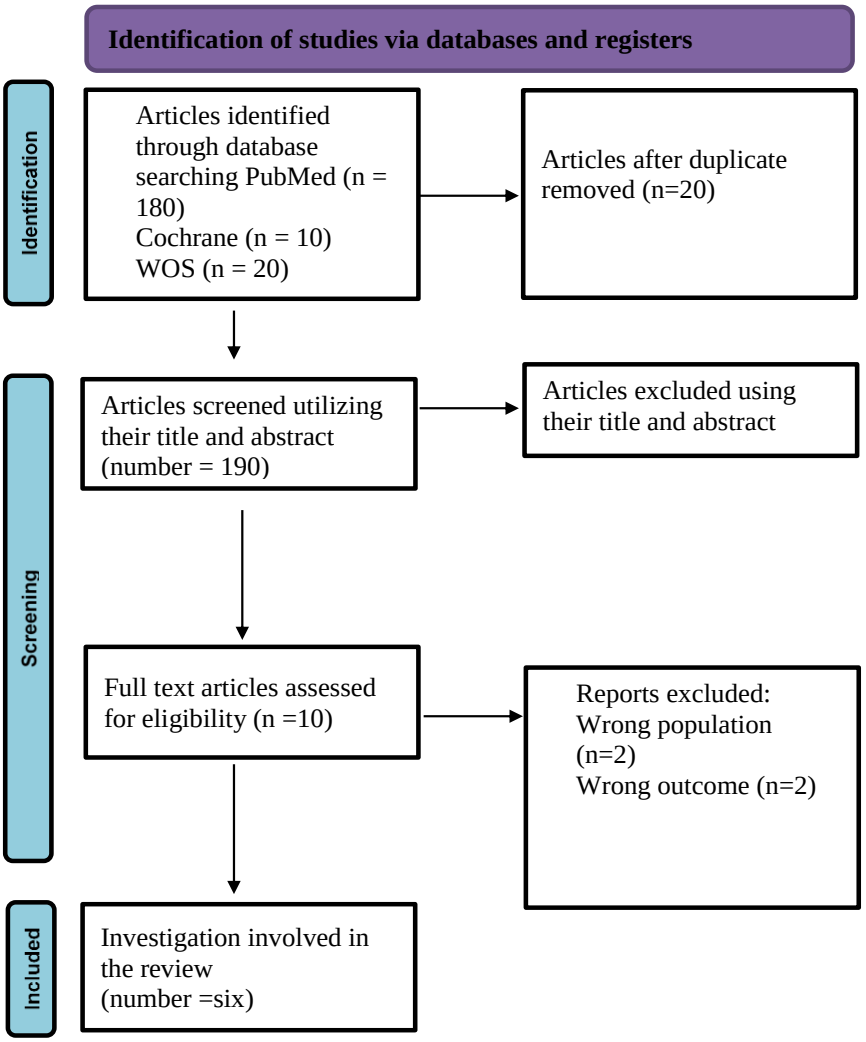

Figure 1: A PRISMA flow chart.

3.2. Characteristics of included papers

This systematic review included 6 studies; four studies were cross-sectional studies, one was a prospective study, and one was a retrospective chart review. Our included studies were conducted in a wide area of geographical distribution (Abou-Taleb et al., [9], ElAwady et al., [10] and Al-Fahham et al., [11] were in Egypt, Islam et al., [12] was in Bangladesh, Khasawneh et al., [13] was in Jordan, and Parvar et al., [14] was in Iran). The age of all participants from the included studies ranged between 0-12 years, with a total of 17788 participants, mostly males (55% to 78%). The findings indicated that the frequency of congenital cardiac disorders was 7.8 per 1,000 live

births in the research carried out by Islam et al. [12]. ElAwady et al. [10] reported a frequency of congenital abnormalities of 74 (7.4%) among a thousand neonates in Fayoum Governorate, Egypt. Cardiovascular abnormalities were the most often documented, accounting for 32.4%. Ventricular and atrial septal abnormalities exhibited the highest frequency, occurring more frequently in male neonates than in female infants (**Tables 1, 2**).

Table 1: Baseline characteristics of the involved research.

Study ID	**Publication Year**	**Country**	**Sample Size**	**Type of Study**	**Age (Days)**	**Gender (Males/ Females)**
Abou-Taleb et al. [9]	2017	Egypt	50 neonates	Prospective study	11.78 ±9.4	78%/22%
El Awady et al. [10]	2021	Egypt	1000 neonates	Cross-sectional study	0-28	62.1%/36.5%
Al-Fahham et al., [11]	2021	Egypt	1005	Retrospective epidemiological cross-sectional study	1 day-12 years	54%/46%
Islam et al. [12]		Bangladesh	6560 neonates	Cross-sectional analytic study	10.2 ±9.8	55%/ 45%
Khasawneh et al. [13]	2020	Jordan	1,028 infants	Retrospective chart review	0-30	51%/49%
Parvar et al., [14]	2023	Iran	8145 neonates	Multicenter, cross-sectional observational study	8.5 ± 9.3	The men-to-women ratio was 2.6

Table 2: The main results of the involved investigations.

Study ID	The Main Findings
Islam et al. [12]	• Of the 6560 hospitalized neonates, 51 were diagnosed with a congenital heart disorder. • The prevalence was 7.8% per one thousand live births. • Ventricular septal defect was the most prevalent congenital heart defect at 29%, followed by atrial septal defect at 24%, patent ductus arteriosus at 10%, transposition of the great arteries at 8%, complicated heart disease at 8%, and tetralogy of Fallot at 6%.
Abou-Taleb et al. [9]	• The predominant form of cyanotic congenital heart disease was d-transposition of the great arteries (D-TGA) at 66%, followed by complex cyanotic congenital heart disorder and hypoplastic left heart syndrome (HLHS) at 12% each, while hypoplastic right ventricle constituted the least prevalent kind at 2%.
Khasawneh et al. [13]	• The congenital heart disorders were twenty-five per one thousand live births. 51% were preterm newborns. The predominant cases had moderate congenital heart disease. • Patent ductus arteriosus was the predominant acyanotic lesion, succeeded by atrial septal defect and ventricular septal defect, with prevalence of 44%, 25%, and 25%, respectively. • CCHD comprised 6% of all congenital heart disorder cases. Tetralogy of Fallot is the predominant cyanotic congenital heart defect.
El Awady et al. [10]	• The occurrence of congenital abnormalities was 74 (7.4%) among a thousand neonates in Fayoum Governorate, Egypt. • Cardiovascular abnormalities constituted the most often reported category at 32.4%. Within this group, the predominant anomalies were cardiac septa (10/74; 13.5%).
Al-Fahham et al. [11]	• Acyanotic congenital heart disease has been observed in 796 cases (79.2%), while cyanotic CHD has been noted in 209 cases (20.8%). • The tetralogy of Fallot represented the most prevalent cyanotic congenital heart defect (9.8%). • Whereas the isolated VSD constituted the predominant acyanotic congenital heart defect (19.8%). • Most of their cases received a diagnosis within the first year of life, with 48.9% identified in early infancy and 37.8% within the duration newborn.
Parvar et al. [14]	• The predominant kinds of congenital heart disease have been atrial septal defect (85%) and patent ductus arteriosus (32%). • The frequency of male cases was significantly increased.

Publication bias and study quality

The small number of included studies made it impossible to assess publication bias. However, the quality of the studies was good (**Table 3).**

Table 3: Bias Risk Assessment Using Newcastle-Ottawa Scale

Study ID	Country	Year	Journal	Newcastle–Ottawa Scale
Islam et al. [12]	Bangladesh	2013	Northwest Journal of Medical Sciences (NJMS)	Fear quality
Abou-Taleb et al. [9]	Egypt	2017	The Egyptian Journal of Medical Human Genetics	Good quality
Khasawneh et al. [13]	Jordan	2020	Frontiers in Pediatrics (Sec. Pediatric Cardiology)	Good quality
El Awady et al. [10]	Egypt	2021	The Eastern Mediterranean Health Journal (EMHJ)	Good quality
Al-Fahham et al. [11]	Egypt	2021	The Egyptian Heart Journal	Good quality
Parvar et al. [14]	Iran	2023	Health Science Reports	Good quality

4. Discussion

This systematic research aimed to discover the frequency of complicated congenital cardiac disorders among newborns in the Fayoum governorate.

The worldwide rate of congenital cardiac abnormalities in infancy is stated as 0.003 95% confidence interval [CI], 0.002–0.004), or more precisely 0.0027 (95% CI: 0.0022–0.0035), equating to 0.27%, 2.78 per 1,000, and 27.8 per ten thousand births. The annual rate of congenital cardiac disorders in infants is rising globally. Ventricular and atrial septal abnormalities exhibited the highest frequency, occurring more frequently in male babies than in female babies [15].

In Egypt, the research by Al-Fahham et al. aimed to determine the distribution of baseline characteristics, kinds, age, prenatal risk factors, and modes of presentation of congenital heart disease among Egyptian children [11]. A total of 1005 cases' medical records have been involved. There were 545 males (54%) and 462 females (46%), resulting in a ratio of 1.2:1. Acyanotic congenital heart disorder has been observed in 79.2% of cases. Isolated tetralogy of Fallot and ventricular septal defect was the most frequent cyanotic and acyanotic lesions, respectively, in this patient. Most cases that were diagnosed occurred in young mothers (91.3%), and most cases were diagnosed within the 1st life’s year (86.7%

of cases). The accidental identification of a murmur was the most common manifestation (35%). Heart failure has been identified within 44%, audible murmurs in 74.4%, maternal diseases in 54%, consanguinity in 44.6%, preterm in 19.3%, assisted reproduction in 11.7%, family history of congenital heart disease in 9.2%, abortions in 7.1%, and extracardiac defects in 3.6% of the examined group. Down syndrome (DS) is the most prevalent chromosomal abnormality, with atrioventricular septal defect being the most distinctive heart lesion associated with it. They determined that there is no gender preference among Egyptian kids with congenital heart disease. Most patients are identified during early childhood. The accidental detection of a murmur is the predominant manner of presentation. The Egyptian population exhibits a multitude of contributing risk factors.

Parvar et al. found 6,307 cases of congenital heart disease among 8,145 live neonates suspected of having CHD [14]. The most prevalent defects of cyanotic defects identified were transposition of the great arteries (two per one thousand newborns), TOF, and single ventricle, while the most frequent acyanotic defects were atrial septal defects (eighty-five per one thousand newborns), then VSD and PDA. The research indicated a significantly greater frequency of congenital heart disease in male newborns with a male-to-female ratio of 2.6. This aligns with prior investigations indicating a greater prevalence of CHD in male infants [16].

The frequency of congenital cardiac abnormalities varies significantly among nations. The frequency of congenital heart disease in Iranians varies between 4.2 and 8.6 per 1000 live births [17]. A recent report published in China indicated that atrial septal defects were the predominant congenital heart defect among all participants [18].

Hasan et al. stated the frequency of congenital heart disease observed within the largest maternity hospital in Jordan [19]. The prevalence of congenital cardiac disease has been identified as 17.8 per one thousand live births. This increased to 24.6 per one thousand when patent ductus arteriosus in preterm newborns was added. Most often discovered anomalies included chronic pulmonary hypertension, patent ductus arteriosus, septal hypertrophy, atrial septal defect, and ventricular septal defects. Most kids have been assessed either for a detected

murmur during examination or as part of screening related to risk factors or other comorbidities. Below 1% of children received a prenatal diagnosis. The frequency of chronic pulmonary hypertension has been elevated throughout the COVID-19 pandemic compared to prior periods ($p < 0.001$). They determined that a significant prevalence of congenital heart disease was discovered in Jordan. Enhanced perinatal and prenatal screening for congenital heart disorders may facilitate early identification.

The cause of this elevated frequency of CHD requires further examination. Elevated levels of consanguinity were recognized as a risk factor for coronary heart disease within many regional countries and in systematic studies [20]. This was suggested as a potential cause for the elevated frequency of congenital heart disease and other congenital defects in Jordan [13]. Environmental, racial, or socioeconomic variations may potentially contribute to the elevated frequency of CHD. Evidence suggests a differential occurrence of some lesions among ethnic groups [4]. A diverse array of environmental exposures has been associated with coronary heart disease.

5. Conclusion

This systematic review indicated that the occurrence of congenital heart disease was significantly elevated. Atrial septal and ventricular abnormalities exhibited the highest frequency, occurring more frequently in male neonates than in female infants. The enhancement of diagnostic facilities in various places significantly impacts the reduction of these anomalies. Timely identification is essential in diminishing mortality associated with these illnesses. It is essential to establish policies aimed at decreasing the frequency of complicated congenital cardiac disorders and preventing infant mortality associated with these conditions.

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