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Cardiovascular Malformations in Iranian Infants of Diabetic Mothers: A systematic review and meta-analysis

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Abstract

Introduction: Congenital cardiovascular malformations are the most common group of birth defects and affect about 6-8 per thousand of newborns. It has been shown that infants of diabetic mothers have more complex congenital heart anomalies.

Methods: The methods used in this systematic review are developed based on the Checklist Guidelines (PRISMA). The searches were conducted by two independent researchers and the purpose of the search was to find published studies from 1/1/2000 to 5/30/2019.

Results: Based on the random effect model, the total Prevalence of Cardiovascular Malformations in 418 patients was 56% (95% confidence interval and 54% , 59%).

Conclusion: Considering that congenital heart disease is one of the most important causes of infant and child mortality and its early diagnosis prevents death and ideal treatment, early diagnosis and follow-up of various congenital heart diseases is vital.

Keywords: Gestational diabetes; Overt diabetes mellitus; Congenital cardiac anomalies

Introduction

Congenital cardiovascular malformations are the most common group of birth defects and affect about 6-8 per thousand of newborns(1).In most cases, the cause is unknown, some are genetic and some are environmental, and only about 1% of cases are caused by maternal diabetes(2). It has been shown that infants of diabetic mothers have more complex congenital heart anomalies(3).If control of blood sugar is not appropriate in the first trimester of pregnancy, there is a greater susceptibility to congenital diseases(4).The frequency of congenital malformations in the children of diabetic mothers is 10 times higher than the children of non-diabetic mothers, and the rate of spontaneous abortion is 5 times(5).The most common congenital malformations in the neonates of diabetic mothers are congenital heart disease and polymorphism syndrome, and long-term diabetes and poor blood sugar control before and during pregnancy increase the risk of congenital malformations(6).In maternal diabetes, the fetal heart is threatened in two ways. In the first method, at the beginning of pregnancy, diabetes has a teratogenic effect and disrupts cardiogenesis through the gene code responsible for heart development (7). The second method is at the end of the second trimester or The third trimester affects the fetus with pathological

ventricular hypertrophy known as hypertrophic cardiomyopathy(8).Congenital heart disease is diagnosed in 40-50% of cases in the first week of life and in 50-60% in the first month, and only about 20% of patients with septal disorder will need surgery(9).Other causes of congenital heart disease, such as hypoplastic left heart syndrome or tetralogy of Fallot, are life-threatening and require surgical intervention. Diagnosis of congenital heart disease is possible by fetal heart echocardiography.

Methods

Inclusion criteria (eligibility criteria)

The methods used in this systematic review are developed based on the Checklist Guidelines (PRISMA). We included cross-sectional studies, case studies, and cohort studies, and excluded case studies, letters to editors, case reports, clinical trials, study protocols, systematic reviews, and reviews.

Participants: All studies on the Prevalence of Cardiovascular Malformations in Infants of Diabetic Mothers were studied.

Sampling methods and sample size: All observational studies, regardless of their design, were included in the systematic review. The minimum sample size was 25 patients or more.

Search strategy

The searches were conducted by two independent researchers and the purpose of the search was to find published studies from 1/1/2000 to 5/30/2019. Studies published in MEDLINE were searched through PubMed, EMBASETM through Ovid, the Cochrane Library, and the English Trip database. Systematic review articles using MESH phrases and open phrases in accordance with print standards. After the MEDLINE strategy was finalized, the results were compared to search other databases, and PROSPERO was searched for recent or ongoing systematic reviews. The keywords used in the search strategy were: hydatidiform moles, moles, woman, pathology.

Select study and extract data

The two researchers independently analyzed the titles and abstracts of the articles according to the eligibility criteria. After eliminating additional studies, the full text of the studies was collected based on the eligibility criteria and information about the authors if necessary. General information (relevant author, province and year of publication), information about the study (sampling technique, diagnostic criteria, data collection method, research conditions, sample size and risk of bias) and output scale were collected.

Quality evaluation

The developed scale of Hoy et al. was used to assess the quality of the method and the risk of bias in each observational study. This scale collected 10 items to evaluate the quality of studies according to their external validity (items 1 to 4 of the target population, sampling framework and minimum participation bias) and internal validity.

Results

Study selection

A total of 564 articles were extracted through initial searches in various databases. Out of 421 essential studies identified by analyzing titles and abstracts. 387 studies were omitted due to irrelevant titles. 37 articles were removed from 43 existing studies. Out of the remainingstudies, 6 studies met the study criteria. (Figure 1).

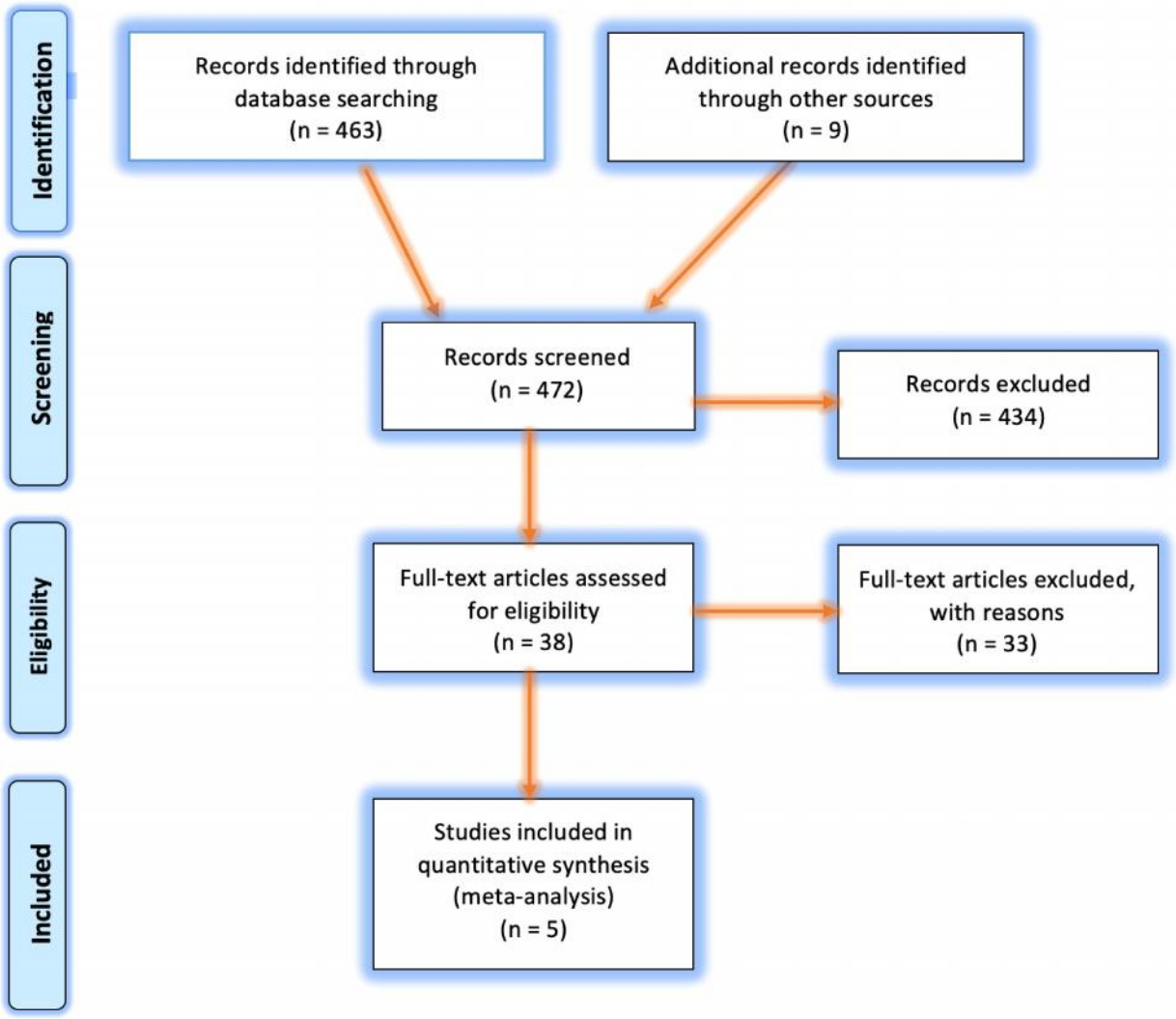

Figure 1:PRISMA flow diagram

Research specifications

A total of 418 patients were evaluated. All studies were retrospective studies. A total of 5 studies from 3 provinces that met the inclusion criteria were reviewed. Among these studies, 3 studies were from Tehran, 2 studies from Qom and Yazdwere included in the study. The risk of bias was low in most studies. The main method of data collection was medical records. The main study sites was hospital (Table 1).

Table 1.characteristics of included studies

Author	Year	Participant	Province	Age	Bias	Prevalence
Najafian [19]	2006	32	Tehran	37.8	Low	46.9%
Ardakani[20]	2011	49	Yazd	---	Low	53.1%
Tabib[21]	2013	102	Tehran	32.17	Low	40%
Arjmandnia[22]	2019	200	Qom	---	Low	49%
Akbariasbagh[23]	2016	35	Tehran	37.4	Low	40%

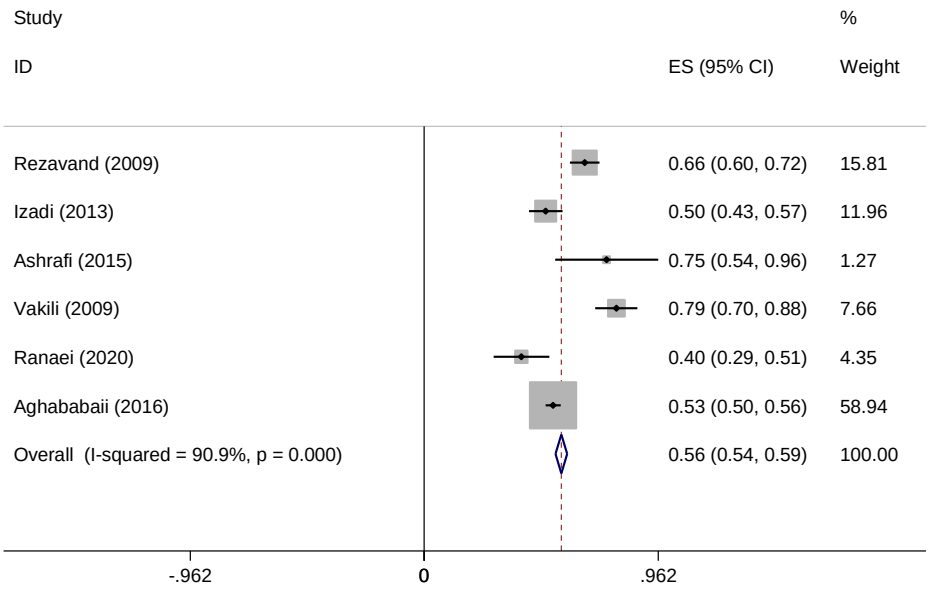

Figure 2: Meta-analysis of the Prevalence of Cardiovascular Malformations in Infants of Diabetic Mothers

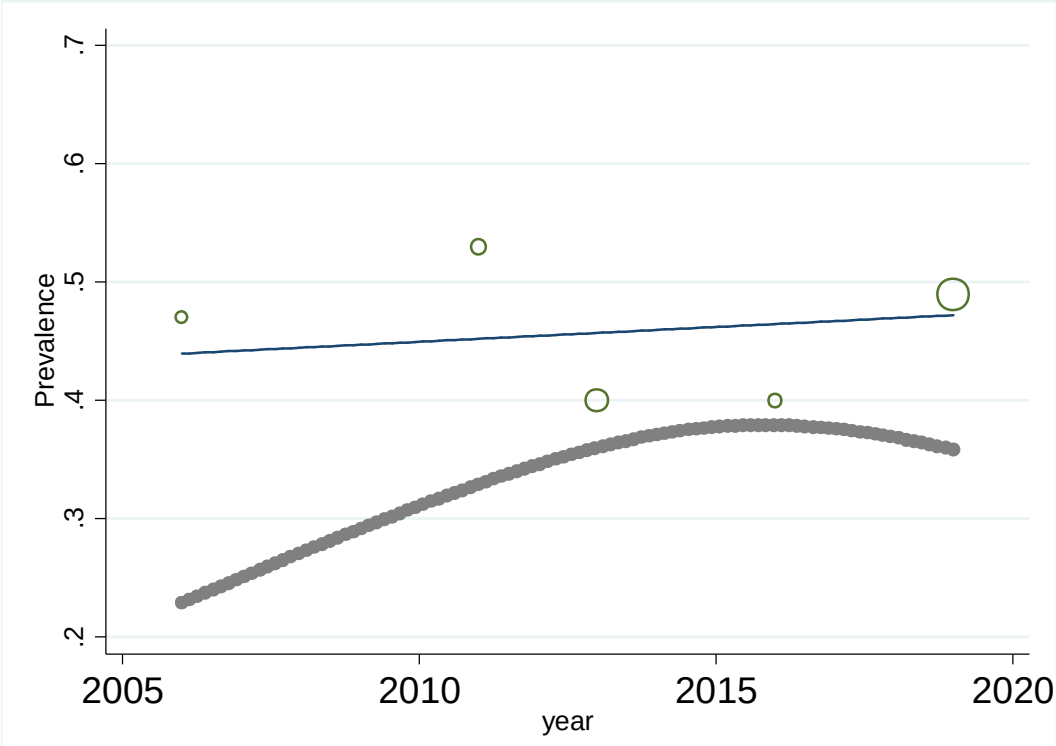

Figure 3 :Meta-regression between year and Prevalence ofCardiovascular Malformations in Infants of Diabetic Mothers

Meta-analysis of the Prevalence ofCardiovascular Malformations in Infants of Diabetic Mothers:

Based on the random effect model, the total Prevalence ofCardiovascular Malformations in 418 patients was 56% (95% confidence interval and 54% ,59%) (Figure 2).

Subgroup analysis:

Meta-regression results:

Results of meta-regression between participants' year and Prevalence of Cardiovascular Malformations :

The meta-regression was evaluated according to the relationship between the Prevalence ofCardiovascular Malformations and participants' Publication year. There was no significant linear trend in univariate meta-regression to explain the change in the effect of age of participants. (Figure 3).

Discussion

Congenital heart disease is an important cause of death in the first year of life and includes a special category of heart disease that exists from birth and is usually due to the abnormal development of normal fetal structures or the cessation of puberty in the early stages(10). Based on the random effect model, the total Prevalence ofCardiovascular Malformations in 418 patients was 56% (95% confidence interval and 54% , 59%) .Most of these diseases are well tolerated in the uterus, but the problems begin after birth with the closure of the arterial canal and oval perforation and the removal of fetal circulation(11).Various studies have been conducted on the prevalence of congenital heart diseases that the prevalence range in different communities has varied from 0.1% to 6.26% (12).·Congenital heart disease can be divided into two categories: cyanotic and non-cyanotic (13).The type of congenital heart disease is known so far, with ventricular septal defects with a prevalence of 20-25% being the most common, followed by atrial septal defects, arterial duct retention and aortic coarctation with a prevalence of 8-13% and 6-11%, respectively (14). And 5-7% have the highest frequency.Genetic defects, prematurity, maternal age, maternal diseases, and drug use during pregnancy form the etiology of congenital heart disease (15) ·Prenatal and postnatal ultrasound studies are a reliable tool in the diagnosis of congenital heart disease(16) . Fetal echocardiography is also very sensitive in the diagnosis of congenital heart disease, but is used only in cases of high-risk pregnancies(17).Diagnosis of heart disease, determining the course of treatment and the need for follow-up is done through consultation with a pediatric cardiologist(18).In case of persistent cyanosis, congestive heart failure, shock, symptomatic arrhythmias, syndromes or dysmorphias, counseling and evaluation for congenital heart disease is indicated.

Conclusion

Considering that congenital heart disease is one of the most important causes of infant and child mortality and its early diagnosis prevents death and ideal treatment, early diagnosis and follow-up of various congenital heart diseases is vital.

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