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Prevalence of Congenital Heart Defects in Neonates in Iran: A Meta-Analysis Study

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Abstract

Background: Congenital heart defects (CHDs) have a major role in neonatal mortality. Given the effect of CHDs on the infant mortality rate (IMR), knowing its prevalence is necessary for health planning The present meta-analysis aimed to investigate the prevalence of CHDs in neonates in Iran. Methods: This is a meta-analysis in which all articles published by Iranian researchers in Persian and English from 1986 to 2015 which contained the keywords of congenital anomalies, congenital heart defects, prevalence, newborn, and Iran were enrolled The articles quality was reviewed using the JBI checklist and the I2 heterogeneity index, and the articles were analyzed by Comprehensive Meta-Analysis, version 3. Results: Out of 1251 papers in the initial studies, 14 papers published from 1986 to 2015 were enrolled in the study according to inclusion and exclusion criteria. The overall prevalence of CHDs was 3.7/1000, which was significantly lower than its prevalence before 2008. Conclusion: Given the high prevalence of CHDs in Iran, further studies can address them better and more accurately aiming to prevent their occurrence.

Key words: Prevalence, Congenital Heart Defects, Iran, Newborn.

Introduction

Congenital anomalies are referred to any anatomical defects at birth that have medical complications and may require surgical and medical interventions (Marokakis, Kasparian and Kennedy, 2016; Toobaie et al., 2019) with a neonatal mortality rate of 20-25% (Griggs et al., 2013).

Congenital heart defects (CHDs) are among the life-threatening complications of infants that affect the infants' heart structure and function. They can be mild and severe, the latter being associated with more intense complications (Hartman et al., 2011; Botto, 2015). The prevalence of CHDs is 10-25% in the aborted fetus, about 4% in stillbirth, 2% in premature infants, and about 0.8% in newborns (Gilboa et al., 2010). CHDs have unknown causes, but the main causes are genetic changes, nutrition and drug consumption of mothers, and environmental factors (Qu et al., 2016).

CHDs have adverse effects on infants, their parents and family, and the health system, such as depression, high treatment costs, mortality, *etc.* (Morvarid et al., 2018); therefore, identification of these unwanted complications is necessary during fetal development to prevent their occurrence. CHDs can be diagnosed through fetal cardiac echocardiography and if it is performed in suspected cases, the occurrence of CHDs can be reached to zero (Forsey J, Friedberg MK, Mertens, 2013; Dehghani et al., 2017). Congenital heart defects are among the causes of infants and children death, and their early diagnosis prevents infant mortality and leads to ideal treatment. This is an important anomaly which can economically and psychologically affect the society, the health system, and families, as well as the

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infant mortality rate (IMR) as an important indicator of health and development of a community; therefore, knowing the prevalence of CHDs in the country can help health planners at national level aiming to reduce the disease burden. Meta-studies can provide precise and valid results due to their high sample volumes resulting from combination of various studies and hence reducing the confidence intervals of these sizes and solving problems arising from the controversial results of past studies. Since several studies have been conducted on the prevalence of congenital anomalies and CHDs in Iran, implementing a meta-analysis seems necessary in order to validate the results of these studies and obtain accurate and valid results for planners and researchers. In this regard, the present meta-analysis was conducted to determine the prevalence of congenital heart defects in neonates in Iran.

Methods

Inclusion and exclusion criteria

This is a structured and meta-analytic review carried out based on studies conducted in Persian and English with no time limit. Inclusion criteria were descriptive cross-sectional studies that examined the incidence of CHDs and exclusion criteria were review, interventional, and cohort studies, letter to the editor, and case studies on the prevalence of CHDs. Therefore, all articles with the mentioned criteria published from 1980 to 2018 were included in the study.

Article searching strategy

All articles published by Iranian researchers in Persian and English at SID, PubMed, ScienceDirect, Springer, MEDLINE, Web of Science, Embase, Scopus, ProQuest, and Magiran databases, and the Google scholar search engine aiming to determine the prevalence of congenital anomalies (including CHDs) were included. The target keywords included congenital anomalies (Mesh), congenital heart defects (Mesh), prevalence (Mesh), newborn (Mesh), and Iran (Mesh). The articles were first searched according to the mentioned criteria. Then, articles whose abstracts or original text were not available or did not mention the sample size were deleted. In order to reduce the bias, articles were independently searched by two researchers, and in case of disagreement about eligibility of an article, that article was judged by another researcher expert in meta-analysis.

To evaluate the quality of articles enrolled in this meta-analysis, the Joanna Briggs Institute (JBI) checklist used in the study Irani *et al.* was utilized. This checklist is the most popular and standardized international checklist for evaluating the quality of articles. The checklist contains 9 parts, with a minimum and maximum score of 0 and 9 for each study. Accordingly, the studies can be divided into three groups of poor quality (0-3), medium quality (4-6), and high quality (7-9) (Table 1) (Irani et al., 2018).

Statistical method

The prevalence of abnormalities and the number of samples were extracted in each article; therefore, binomial distribution was used to calculate the variance of each study and weight mean was used to combine the prevalence of different studies. Each study was weighed in proportion to its inverse variance. I^2 was used to evaluate the heterogeneity of the studies. The heterogeneity was 95% in this study, indicating high heterogeneity of the studies, which can be attributed to the difference in population, sampling error, and year of study. Given the heterogeneity of studies, data analysis was performed using CAM ver2 to combine studies. After collecting the articles, the data were analyzed using the Comprehensive Meta-Analysis version 3.

Results

In this study, all Persian and English studies regarding the prevalence of congenital heart defects in neonates in Iran were studied systematically, without time constraints, based on the four steps of PRISMA. In the initial search, 1251 articles were identified and finally, 14 papers were included from 1986 to 2015 (diagram 1). It should be noted that all studies were descriptive cross-sectional.

The total sample size was 143520 and the mean sample size in each study was 10251. The lowest and the highest sample size pertained to the Hemetyar *et al.* and Mohsenzadeh *et al.* studies, respectively. The highest prevalence of CHDs was reported by Dastgiri *et al.* (8.2%; 129 in 1574 patients) and the lowest by Khatami *et al.* (1.0%; 11 in 10450 patients). The prevalence of CHDs in articles used in this meta-analysis is given in Table 2.

The estimated prevalence of CHDs in 14 articles was 3.7/1000 ranging from 0.1/1000 to 8.2/1000. Since the studies had focused on the prevalence of all congenital malformations, no study has reported the ratio of malformations in girls and boys as well as the type of cardiac anomalies.

The results showed that the prevalence of CHDs was 5.2/1000 by 2008 after which reached 3.0/1000, indicating a significant decrease in the prevalence of this health problem in Iran.

Discussion

According to the results of this meta-analysis, the prevalence of CHDs in Iranian infants is 3.7/1000. The true rate of CHDs seems to be greater than what reported in this study, and the present study has underestimated the prevalence of CHDs, because part of the CHDs occurs in the fetal period and results in fetal mortality. In addition, some abnormalities may not be apparent until many years after birth. Therefore, it should be noted that the prevalence reported in this study is the least prevalence of CHDs and the mentioned cases were not calculated due to the lack of attention paid in the studies enrolled in the meta-analysis.

The prevalence of this abnormality in the present study is not consistent with the general prevalence of Daliri *et al.* study (1.8/1000) (Daliri et al., 2018). The prevalence of CHDs is 19.14/1000 in India (Bhardwaj et al., 2015), 11.1/1000 in China (Qu et al., 2016), 1.9/1000 in Iraq (Dagash and Saleh, 2015), and 1.7/1000 in Turkey (Korkmaz et al., 2015); it is much lower in the United States (0.64-0.90/1000) than Asian countries (Thompson et al., 2015).

In a review study by Van Der Linde *et al.* in 2011, the prevalence of CHDs was steadily increasing until 1995 (6/1000 before 1930 to 19/1000 by 1995), after which it had a steady amount (van der Linde et al., 2011).

According to the results of this study, the prevalence of CHDs in southern Iran is higher than other regions. Although the present research is not an analytical study and the cause of CHDs cannot be determined, the high prevalence of CHDs in this region and in Iran can be attributed to the high prevalence of familial marriages in Iran. On the other hand, changes in lifestyle can be another reason for the high prevalence of CHDs.

The prevalence of CHDs in studies before 2008 was higher than studies after 2008 (1.73 fold), which indicates a decline in the prevalence of CHDs. This decreasing trend can be attributed to increased access to health services, increased public awareness, screening measure, use of folic acid and multivitamins before and during pregnancy, avoidance of infectious and teratogenic agents, and vaccination against contagious diseases.

In general, it can be said that the difference in prevalence of CHDs in different regions of Iran and in Iran compared to other countries, may arise from differences in genetic, racial, cultural, socioeconomic factors among different people and differences in the method of examining CHDs rate. On the other hand, differences in the methodology of studies and the type of study population (living or dead newborns, infants, and children) can be the reason for differences in studies.

The current study is important because knowing the prevalence of CHDs throughout the country can help plan and manage the existing resources to prevent CHDs. The heterogeneity of studies, difference in the method of examining malformation rate, and lack of chromosomal test and diagnosis were the limitations of the present study.

As a weak point of the present study, the type of cardiac abnormality has not been reported in studies. On the other hand, all abnormalities are not recognized at birth or even in the first year of birth; therefore, the prevalence can be less or more than real. As a result, it is suggested to determine the prevalence and the type of cardiac abnormalities in future studies without limitations of this study.

Conclusion

The prevalence of CHDs in Iran is higher than developed countries; therefore, further studies are needed to better and more accurately address this issue in order to prevent the occurrence of CHDs.

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Conflict of interest statement

There is no conflict of interest between authors.

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Table 1: Evaluation of the articles quality based on the JBI checklist

Selected study	Attrition and no participation in the study	Appropriate statistical analysis	Similar measurement method for all samples	Use of a valid method for measuring	Adequate coverage of samples for analysis	Explanation of the environment and participants	Adequate sample size	Appropriate selection of samples	Samples are representative of the target population	Total score
Farhud (1986)	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
Movahedian (2001)	No	Yes	Yes	No	Yes	No	Yes	Yes	Yes	6
Hemetyar (2003)	No	Yes	Yes	Yes	No	No	No	Yes	Yes	5
Khatami (2005)	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	8
Hematyar (2005)	No	Yes	Yes	Yes	No	No	No	Yes	Yes	5
Karbasi (2009)	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	7
Dastgiri (2007)	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes	6
Ahmadzadeh (2008)	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
Aliakbarzadeh (2008)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Mohsenzadeh (2011)	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
Masoodpoor (2013)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Abdolahi (2014)	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	7
Nasab (2014)	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
Jalali (2015)	No	Yes	Yes	No	Yes	No	No	Yes	Yes	5

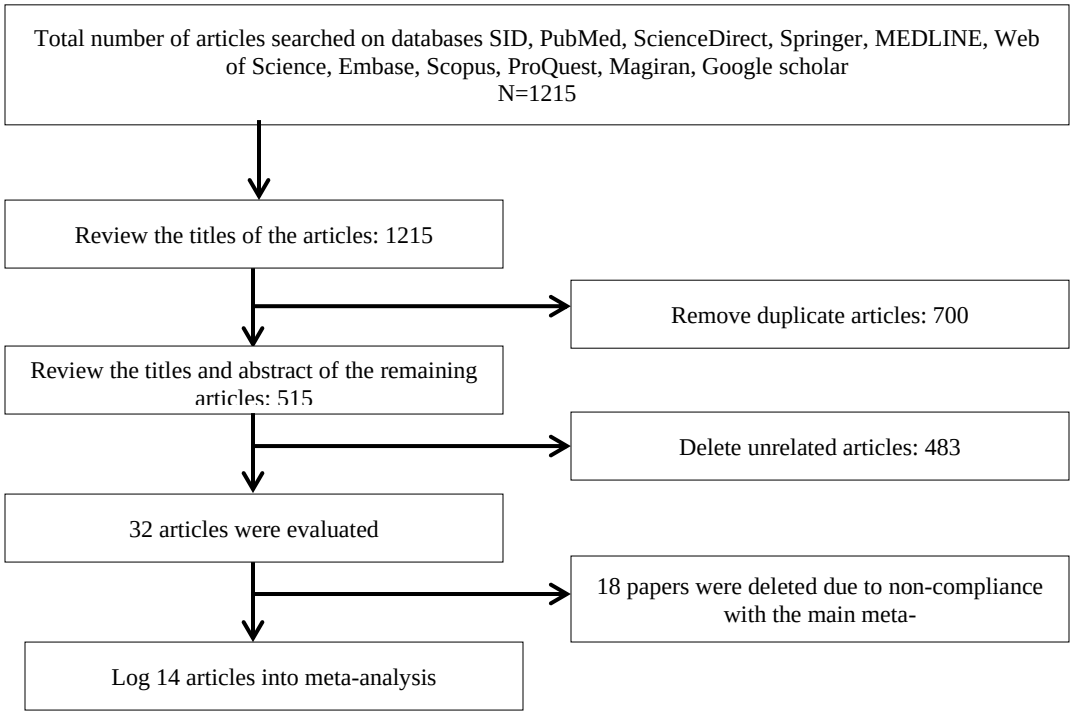

Figure 1: Diagram of the stages of study entry into meta-analysis