

## Prevalence and Pattern of Congenital Heart Disease among Neonates in Gorgan, Northern Iran (2007-2008)

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### Abstract

**Objective:** Congenital heart disease (CHD) is the most common congenital anomaly in newborns. The aim of this longitudinal, hospital-based study was to evaluate the prevalence and pattern of CHD among Iranian newborns in Gorgan, Northern Iran.

**Methods:** 11739 live births in Dezyani hospital in Gorgan were screened for CHD, 2007 through 2008. Clinical examination, echocardiography, color Doppler and cardio catheterization were used as diagnostic tools. Clinical and demographic factors, namely sex, type of CHD and associated anomalies of diagnosed cases were recorded in a pre-designed questionnaire for analysis.

**Findings:** The overall prevalence rate of CHD was 8.6 per 1000 live births. This was 9.96 per 1000 male births and 7.34 per 1000 female births. It was 4.5 and 13.19 per 1000 in 2007 and 2008, respectively. ASD was the commonest lesion (2.64 per 1000), followed by VSD+ASD (1.28 per 1000) and PDA (1.28 per 1000). The rate of ASD in male and female was 3.02 and 2.26 per 1000 respectively. Parents of 40 (39.6%) babies were related. 39 (38.6%) couples were first cousins.

**Conclusion:** This study showed that the prevalence of CHD among live births in Gorgan is lower than reported in the studies for Middle East and European countries.

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**Key Words:** Congenital Heart Disease; Prevalence; ASD; VSD; Gender; Iran

### Introduction

Congenital heart disease (CHD) is the most common congenital anomaly in newborns. Also it is a leading cause of death during the first year

of life with a prevalence of 1% in live births<sup>[1]</sup>. Etiology of CHD is multifactorial and a large collection of environmental and genetic causes have a role in its pathogenesis<sup>[2]</sup>.

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Malformations of the cardiovascular system are also associated with significant medical morbidity, which requires use of costly medical facilities [3]. Thus, determining the prevalence and pattern of CHD is necessary to recommend valuable changes in health policies [4]. CHDs are relatively common with a prevalence ranging from 3.7 to 17.5 per 1000 live births [3,4].

Several previous reports suggest a changing pattern and incidence of congenital heart disease in various geographic locations [5,6] according to racial and ethnic factors [3,7]. Knowledge of the epidemiology of congenital heart disease is the basis on which investigative efforts will emerge to identify the causes of cardiac dysmorphogenesis and afford opportunities to prevent them [8].

There is no information about the prevalence rate of congenital heart diseases in Gorgan. Therefore, the objective of this study was to estimate the pattern and the prevalence rate of congenital heart diseases in a referral hospital in Gorgan, which is the capital city of Golestan province in northern Iran.

## Subjects and Methods

This longitudinal and hospital-based investigation was undertaken on all 11,739 live births to identify all newborns with congenital heart malformation, born between January 1, 2007 and December 31, 2008, in Dezyani - a teaching hospital and a referral center which is the main site for about 80% of deliveries in Gorgan, Iran. Dezyani is a referral hospital with an annual rate of more than 6000 deliveries, accounting for 20% of annual births in Golestan province. The largest portion (80%) of deliveries in the city and other deliveries (20%) in Gorgan city are carried out in four private hospitals and in hospitals of Ministry of Labor. Golestan province has a population of about 1.8 million and covers an area of about 20460 kilometer square. Patients are usually from moderate to low socioeconomic class families.

Live newborns delivered in this hospital during the investigation were examined and

screened for CHD and follow-up for six months. Different types of CHDs considered for the present investigation are: Ventricular Septal Defect (VSD), Atrial Septal Defect (ASD), Tetralogy of Fallot (TOF), Patent Ductus Arteriosus (PDA), Pulmonary Stenosis (PS), Transposition of Great Arteries (TGA), Total Anomalous Pulmonary Venous Connection (TAPVC), Partial Anomalous Pulmonary Venous Connection (PAPVC), Pulmonary Arteria (PA), Single Ventricle (SV), Ebstein Anomaly (EA) and Complex CHDs (various types of CHDs existing together including rare type of CHDs).

Clinical examination, 2D echocardiography and color Doppler and cardiac catheterization were considered as definitive tools for diagnosis of CHD. Variables recorded included the date of birth, sex, type of malformation and the presence of other congenital malformations. The total number of live figures of every year was recorded.

The ethical committee has approved the study. Descriptive data are presented as percentages. Descriptive statistics was calculated for CHD prevalence per 1,000 live births. The prevalence of CHD is calculated as follows:

Annual rate = CHD cases/total live births.

Confidence interval (<sup>95%</sup>CI) for prevalence was calculated by binomial exact methods.

STATA8/SE statistical package was used for statistical analysis.

## Findings

The overall prevalence of CHD live births during this 2-year period was 8.6/1000 live births. CHD was found to be more common in male than female births (9.96 versus 7.34 per 1000). The risk of CHD in males was 1.35 times more than in females (OR=1.35, <sup>95%</sup>CI 0.81-2.02 P>0.05). The rate of CHD was 4.53 per 1000 in 2007 and 13.36 per 1000 in 2008.

The Pattern and prevalence rate of congenital malformations according to sex is depicted in Table 1.

**Table 1:** Cardiovascular malformations distribution by sex

<b>Congenital Heart Disease</b>	<b>Male</b>	<b>Female</b>
<b>Atrial Septal Defect (ASD)</b>	18	13
<b>Ventricular Septal Defect (VSD)</b>	9	1
<b>Patent Ductus Arteriosus (PDA)</b>	6	9
<b>VSD &amp; ASD</b>	6	9
<b>Tetralogy of Fallot</b>	1	1
<b>Mitral regurgitation</b>	2	0
<b>ASD and PDA</b>	1	1
<b>VSD and PDA</b>	1	0
<b>Tricuspidal regurgitation</b>	1	1
<b>Pulmonary hypertension</b>	1	0
<b>Pulmonary stenosis</b>	2	2
<b>Patent Foramen Ovale (PFO)</b>	1	0
<b>Tricuspid Regurgitation (TR) and Pulmonary Regurgitation</b>	2	0
<b>PR and Pulmonary Stenosis (PS)</b>	1	0
<b>VSD, ASD and PDA</b>	3	1
<b>PS, TR and VSD</b>	2	0
<b>Mitral Valve Prolapse</b>	1	0
<b>Coarctation of the Aorta, PDA and Pulmonary Hypertension</b>	0	1

ASD was the commonest lesion (2.64 per 1000), followed by VSD +ASD (1.28 per 1000), PDA (1.28 per 1000) and VSD (0.85 per 1000). The rate of ASD in males and females was 3.02 and 2.26 per 1000 respectively. The rate of VSD in males was 1.54 and in females 0.17 per 1000 ( $P < 0.05$ ). PDA and VSD+ASD were found to be more common in females than in males (Table 1).

Parents of 40 (39.6%) babies were related. 39 (38.6%) couples were first cousins and 1% were weakly related. None of the affected newborns had a positive family history of birth defects. Hypertension, diabetes, thyroid disorder and history of stillbirth were found in 1% of mothers.

Two (2.6%) newborns with CHD had other congenital anomalies; one was Down syndrome, the other one had neural tube defect.

## Discussion

This study was conducted to explore the pattern and the prevalence rate of CHD in Gorgan. The overall prevalence of CHD during this 2-year period was 8.6/1000 live births.

There is just one study available from Iran which gives the incidence of CHD per 1000 live births by Rahim et al, 2008<sup>[9]</sup>. They reported the prevalence of 12.30/1000 live births. Our estimation of prevalence cannot be compared to this earlier study, because they included all CHDs in age groups ranging from 0 to 60 years in Khuzestan province of Iran in southwest of the country, bordering Iraq and the Persian Gulf. Its capital is Ahwaz and covers an area of 63,238 km<sup>2</sup> and population of 4.3 million. Our province has racial/ethnic and environmental differences with Khuzestan province.

In our study the overall prevalence of CHD (8.6/1000) is higher than in the findings of Fixler in Dallas, USA<sup>[3]</sup> and of Beqic in Tuzla, Bosnia-Herzegovina<sup>[10]</sup>, Spain<sup>[11]</sup>, England<sup>[12]</sup>, Finland<sup>[13]</sup>, Germany<sup>[14]</sup>, Oman<sup>[15]</sup>, North African Arabs<sup>[16,17]</sup>, Thai and Pakistani populations<sup>[18,19]</sup>, but it is lower than in Italians<sup>[20,21]</sup>, Qatari<sup>[22]</sup>, and Iceland populations<sup>[23]</sup>. The reported prevalence in Indian population tends to be higher than in other populations<sup>[24]</sup>.

The prevalence and pattern of individual congenital heart diseases in North Iran and different parts of the world is depicted in Table 2.

**Table2:** The prevalence of individual congenital heart diseases in per/1000 recorded during 2007-2008 in North Iran and different parts of the world

Author	ASD	PDA	VSD	PS	TOF	VSD+ASD	Country
Present study	2.64	1.28	0.85	0.34	0.17	1.28	North Iran
Rahim et al <sup>[9]</sup>	1.95	1.80	1.10	3.60	1.70	-	South-West Iran
Antia <sup>[26]</sup>	1.42	1.80	2.70	1.23	1.23	-	Nigeria
Kapoor and Gupta <sup>[24]</sup>	1.89	1.46	2.13	0.32	0.46	0.04	India
Alabdulgader <sup>[25]</sup>	1.15	0.86	3.95	0.89	0.42	-	Saudi Arabia
Subramanyan et al <sup>[23]</sup>	1.44	1.03	2.49	0.88	0.96	-	Oman
Marelli et al <sup>[28]</sup>	3.89	0.31	4.20	0.5	0.49	-	Quebec (Canada)
Shah et al <sup>[29]</sup>	0.27	-	3.39	-	0.76	-	Dharan (Nepal)
Yang et al <sup>[30]</sup>	0.27	1.58	2.27	0.62	0.31	0.08	China
Fixler et al <sup>[3]</sup>	0.70	0.53	4.28	0.89	0.35	-	Dallas (USA)

ASD: Atrial Septal Defect / PDA: Patent Ductus Arteriosus / VSD: Ventricular Septal Defect / PS: Pulmonary stenosis / TOF: Tetralogy of Fallot

The differences among these results in different parts of the world could be related to the study population, type of classification, and various selection criteria such as live births and still births in the study or methods of diagnosis and racial/ethnic differences.

The most frequent type of CHD was found to be ASD which is in accordance with another study in Iran<sup>[9]</sup> while in other studies <sup>[8,10,16,20-23]</sup> the most frequent type of CHD was VSD. This could be due to the severity of defects which might have led to the death of patients before accessing the medical facilities. This might also be due to racial and genetic factors in different populations.

The prevalence of CHD in North Iran similar to other studies in Iceland, Italy and Spain<sup>[11,20,23]</sup> had an upward trend during the period of study which might be due to the improvement of diagnosis, attention or awareness among the medical authorities. Further study is needed to explore the exact ethological factors.

We found that CHD was more common in male births. This finding is not similar to that reported in Saudi Arabia<sup>[25]</sup>, and Iceland<sup>[23]</sup>, where the frequency was the same for males and females while in Nigeria<sup>[26]</sup> CHD was found to be more common in female births.

Also, researchers have pointed out the effect of race/ethnicity on CHD prevalence<sup>[3,7]</sup>. Racial/ethnic differences in the prevalence of cardiac malformations in utero and at live birth may have environmental components, e.g.,

nutritional status and teratogen exposure, in addition to genetic factors<sup>[27]</sup>.

In our study, associated anomalies were seen in 2.2% of cases; this rate was 9.0% (extracardiac anomalies) and 8.6% (chromosomal anomalies) in Manetti's study in Italy<sup>[20]</sup>, 12.0% (extracardiac anomalies) and 3.80% (Down's syndrome) in Iceland<sup>[23]</sup> and 5.0% in Nigeria<sup>[26]</sup>. In present study, the associated anomalies were CNS anomalies and Down syndrome, while in Antia's study in Nigeria it occurred in the alimentary tract.

This study had certain limitations. Firstly, we cannot state the number of severely ill children who died during initial steps of resuscitation (before the echocardiography could be performed). Secondly, we could not assess the fate of very small acyanotic lesions like tiny VSD.

## Conclusion

The present study shows, for the first time, the prevalence and pattern of CHD in Gorgan, a city in northern Iran. These findings will help establish a database for future studies, which will focus on etiology and ethnic disparity of CHD in the region. The findings can help to establish valuable changes in health policies for the improvement of diagnostic and therapeutic facilities.

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**Conflict of Interest:** None

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