Original Article

Incidence and Associated Factors of Major Congenital Anomalies in Newborns in Chaharmahal and Bakhtiari, Southwest of Iran

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Abstract

Background: Congenital anomalies are among the causes of disability and death in infants. This study aimed to determine the incidence of major congenital anomalies (MCA) recorded at birth and also their relationship with some related factors in neonates born. **Methods:** In this cross-sectional study, all infants born from March 2016 to March 2017 in the hospitals of Chaharmahal and Bakhtiari Province were evaluated for MCA at birth. Information recorded in the medical file including parent and infant characteristics is extracted from the maternal and newborn electronic files. Data were analyzed using Generalized Linear Model with function of Poisson. **Results:** Of the 19666 newborns studied, 63 (3.2 per 1000) had MCAs at birth. Variables such as number of pregnancies, parity, gestational age, neonatal birth weight, height, and head circumference were found to be significantly associated with MCA based on the crude model (P value < 0.05). Using adjusted model 1, the incidence of MCA was found to be significantly related to mother's place of residency and her parity. Finally, in adjusted model 2, the incidence of MCA was found to be related to gestational age, neonatal birth weight, and head circumference. **Conclusions:** In some MCA, early diagnosis and treatment can prevent disability. Consequently, the emphasis on public education to consider appropriate gestational age, proper nutrition before and during pregnancy, and prenatal care is necessary to inhibit MCA.

Keywords: *Incidence, Iran, major congenital anomalies, newborn, risk factors*

Introduction

As defined by the World Health Organization (WHO), congenital anomalies (CA) are also known as birth defects, congenital disorders, or congenital malformations. CA can be defined as structural or functional anomalies that occur during intrauterine life and can be identified prenatally, at birth, or sometimes may only be detected later in infancy.[1] According to report by WHO, approximately 295,000 newborns die within four weeks of birth every year worldwide because of CA.[1]

These abnormalities vary in terms of intensity, they can be divided into major and minor types.[2] Minor or mild anomalies involve a structural change that does not require treatment or can be treated easily without serious consequences. Major anomalies are called anatomical anomalies that are likely to affect one's life and normal functioning. These anomalies require surgery, restoration, and treatment interventions.[2-7]

Although approximately 50% of all CA cannot be linked to a specific cause, there are some known genetic, environmental, and other causes or risk factors. Therefore, investigating these causes and risk factors may help to prevent the anomalies.[1]

The incidence of CA has been reported in various countries of the world (1.38–7.6%)[8-18] as well as in various parts of Iran (0.4–5.5%),[2-4,6,19-23] but no information is available on the incidence in Chaharmahal and Bakhtiari Province, southwest of Iran. The findings of this study not only help to raise the awareness regarding the present situation and identify the factors related to the occurrence of major congenital anomalies (MCA) in this area but also help to remove the factors that are likely to cause anomalies and as a result, prevent some of the MCA.

Methods

In this cross-section study conducted in 2019, all neonates born in the hospitals of Chaharmahal and Bakhtiari Province, including Hajar, Imam Ali, Seyed

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al-Shohada, Shohada, Imam Reza, Imam Javad, Valiasr, Imam Sajad, which had maternity ward, from March 2016 to March 2017 were evaluated in terms of the presence of MCAs. The sample size was the total number of alive newborns in the mentioned hospitals.

The data were collected by using the medical (electronic) file of pregnant mothers through the maternal and newborn system. The information includes parental characteristics, such as maternal age, family marriage, maternal education, place of residence, maternal nationality, number of pregnancies, parity, and previous abortion history and infant characteristics, such as neonatal gender, neonatal multiple, type of childbirth, gestational age, infant weight, infant height, infant head circumference, and type and number of MCA at birth.

To double check and clean the data in the medical files of all those who had MCAs were compared with the file of maternal and newborn system. Additionally, the data were re-purified meaning that it was ensured that infants who had been recorded to have MCAs should have at least one type of anomaly and those who had been recorded to lack malformations were checked for MCAs.

The data were analyzed using statistical software STATA.14. Descriptive analysis was used to determine mean ± SD, frequency (%), and univariate analytical analysis with independent *t*-test and Chi-square test. Incidence relative risk (IRR) of MCAs was also estimated based on maternal and neonatal characteristics using generalized linear model with function of Poisson and link of log. The confidence interval and significance level were set at 0.95 and 0.05, respectively.

Results

A total of 19,666 newborns born in the hospitals of Chaharmahal and Bakhtiari Province in 2016 were studied. About 5390 neonates were in Shahrekord Hajar hospital, 3601 in Imam Ali Farrokhshahr hospital, 447 in Imam Reza Ardal Hospital, 2,503 in Valiasr Borojen Hospital, 2,115 in Seyed al-Shohada Farsan Hospital, 5,458 in Shohada Lordegan Hospital, and 152 infants were born at Imam Javad Naghan Hospital. About 10,048 neonates were boys and 9,611 were girls and seven cases had sexual ambiguities. The seven cases were randomly assigned into two groups of four boys and three girls. From whom, only two cases were not Iranian national. The mean ± SD fatal age at birth, birth weight, and birth height were 38.4 ± 2.1 weeks, 3081.5 ± 519.1 g, and 49.1 ± 3.3 cm, respectively. The mean ± SD head circumference at birth, mothers age, and number of pregnancy were 34.5 ± 2 cm, 28.2 ± 5.7 year, and 2.3 ± 1.3, respectively.

Of the 19,666 infants born, 19,603 infants without MCA, 59 infants had one type of MCA, and four infants had more than one type of MCA.

The results showed that 63 (3.2 per 1,000) infants had MCAs in which 34, 2, 11, 9, 6, and 1 infants born in Shahrekord hospitals, Ardal hospital, Borujen hospital, Farsan hospital, Lordegan hospital, and Kiar hospital had MCAs. Out of 63 infants with MCA, 59 (93.7%) had one type and four (6.3%) infants had more than one type of MCA.

The incidence of MCAs was higher in infants whose parents had family relationship (0.4%) compared to those whose parents did not (0.3%). The finding was not statistically significant (based on model 1; IRR = 1.5 (95% CI: 0.9–2.5)). The IRR of MCAs in neonates born less than 37 weeks (1.2%) was 2.1 times more than over 37 weeks (0.2%) using model 2 (IRR = 2.1; 95% CI: 1–4.6).

The study revealed incidence of MCAs in infants weighing less than 2,500 g (1.4%) was statistically significant more than those who were more than 2,500 g (0.2%). Based on the adjusted model 2, IRR = 2.4 (95% CI: 1- 5.6). Furthermore, the incidence in infants height less than 45 cm (1.6%) was more than infants height more than 45 cm (0.3%), although the relative risk was statistically significant by crude model (IRR = 6.2; 95% CI: 4.4–11.3), but it was not significant based on adjusted model 2 (IRR = 1.2; 95% CI: 0.5–2.8). The IRR of MCAs in infants with abnormal head circumference (1.2%) was 2.4 times higher than normal head circumference (0.2%), which, based on model 2, is statistically significant (IRR = 2.4; 95% CI: 1.1–5).

Based on adjusted model 1, the incidence of MCAs was found to be higher in urban infants compared to that in rural infants (IRR = 1.7; 95% CI: 1.02–3).

The IRR of MCAs in infants born from fifth and higher delivery (0.9%) was 3.5 times more than infants born from the 2–4 delivery (0.2%) that is statistically significant (IRR = 3.5; 95% CI: 1.4–9.1). Variables such as maternal age, maternal education, family marriage, previous abortion history, method of childbirth, neonatal sex, and neonatal multiple were not found to be significantly associated with MCA based on the adjusted model. More details of the results are presented in Table 1.

Discussion

Findings of this study uncovered that the incidence of MCAs in the total number of newborns born in Chaharmahal and Bakhtiari Province was 3.2 per 1000. Studies both in different parts of Iran and around the world have reported different incidence.

Based on the studies in Iran, the incidence of CAs in the studies conducted by Jalali *et al*. in Rasht 4.2%,[3] Nasab *et al*. in Birjand 0.5%,[19] Golali Pour *et al*. in Gorgan 1.01%,[20] Khatami and Mamuri in Mashhad 1.8%,[21] Hosseini *et al*. in Sistan 1.8%,[2] Gheshmi *et al*. in Bandar Abbas 3%,[22] Hajian *et al*. in Babol 0.4%,[23] Shokouhi *et al*. in Hamadan 2.8%,[4] and Marzban *et al*. 5.5%[6] have

Table 1: IRR of MCA based on the maternal and neonatal characteristics using GLM (Poisson)

Variable Name	Neonate (N)	MCA (N)	Crude IRR (CI=95%)	Adjusted IRR (CI=95%) *Model 1	Adjusted IRR (CI=95%) **Model 2
Maternal age (Year)					
<19	1,108	3	Ref.	Ref.	-
20-34	15,697	48	1.1 (04-1.6)	1.6 (0.5-5.2)	-
>35	2,861	12	1.5 (0.4-5.5)	2.03 (0.5-8)	-
Maternal education					
NO college education	16,449	57	1.7 (0.8-4.04)	2.1 (0.9-5.1)	-
college education	3,014	6	Ref.	Ref.	-
Family marriage					
Yes	6,368	25	1.4 (0.8-2.3)	1.5 (0.9-2.5)	-
No	13,298	38	Ref.	Ref.	-
Place of residence					
Rural	9,030	24	Ref.	Ref.	-
Urban	10,636	39	1.4 (0.8-2.3)	1.7 (1.02-3)	-
Parity					
1	6,932	28	1.7 (1.1-2.8)	1.9 (1.1-3.3)	-
2-4	12,089	29	Ref.	Ref.	-
≥5	645	6	3.9 (1.6-9.3)	3.5 (1.4-9.1)	-
Previous abortion history					
No	16,370	55	Ref.	Ref.	-
Yes	3,296	8	0.7 (0.3-1.5)	0.72 (0.3-1.5)	-
Number of pregnancies ϕ					
1	6,218	26	1.7 (1.1-2.9)	-	-
2-4	12,223	30	Ref.	-	-
≥5	1,225	7	2.3 (1.1-5.3)	-	-
Method of childbirth					
Cesarean	8,133	27	1.1 (0.6-1.8)	-	0.9 (0.5-1.5)
Vaginal	11,533	36	Ref.	-	Ref.
Gestational age (Week)					
Preterm	1,770	22	5.4 (3.2-9.2)	-	2.1 (1-4.6)
Term	17,896	41	Ref.	-	Ref.
Gender					
Male	10,052	31	Ref.	-	Ref.
Female	9,614	32	1.08 (0.7-1.8)	-	1.04 (0.6-1.7)
Neonatal multiple					
Singleton	19,330	62	1.08 (7.8-0.15)	-	5.1 (0.7-37.9)
Multiple	336	1	Ref.	-	Ref.
Weight (g)					
<2500	1,658	23	6.2 (3.7-10.4)	-	2.4 (1-5.6)
≥2500	18,008	40	Ref.	-	Ref.
Height (cm)					
<45	860	14	6.2 (4.4-11.3)	-	1.2 (0.5-2.8)
≥45	18,800	49	Ref.	-	Ref.
Head circumference (cm)					
Normal	17,712	39	Ref.	-	Ref.
Abnormal	1,947	24	5.6 (3.4-9.3)	-	2.4 (1.1-5)

IRR=Incidence relative risk, MCA=major congenital anomalies, GLM=generalized linear models. *Variables related to mothers of infants (maternal age, maternal education, family marriage, place of residence, parity, and previous abortion history) were entered into the model. **Variables related to neonate (method of childbirth, gestational age, neonatal sex, neonatal multiple, neonatal birth weight, neonatal height at birth, and neonatal head circumference at birth) were entered into the model. ΦNumber of pregnancies variable was not included to the GLM model because of collinearity.

been reported. The incidence of CAs varies between 0.4% and 5.5%.

According to studies conducted in other counties, the incidence of CAs reported in the three studies in India

by Bhalerao and Garg,[8] Malhotra and Thapar,[9] and Bhide *et al*.[10] were 1.38%, 6.8%, and 3.2%, respectively. Ndibazza *et al*.[11] in Uganda found out the incidence of CAs was 7.6%. In a study conducted by Nazer *et al*.,[12] the incidence of CAs was 2.7% in nine countries of Latin America. Dolk *et al*.[13] found that in 22 European countries, the incidence of CAs reached 2.35%. In the study conducted in Egypt by El Koumi *et al*.,[14] the incidence of CAs was 2.5%. The incidence of CAs in the studies of Chenge *et al*. in China 1.54%,[15] Oztarhan *et al*. in Turkey 2.07%,[16] Persson *et al*. in Sweden 3.5%,[17] and Lelong *et al*. in Paris 3.3%.[18] The incidence of CAs varies between 1.38% and 7.6%.

It should be noted that the type of anomalies such as major or minor and neonatal evaluation method might be reason for variation in incidence of CAs in different parts of the country and around the world.[3]

This study found a statistically significant relationship between newborn birth weight and MCAs. The results are consistent with the results of the studies in Zanjan, India, Egypt, and Tanzania.[6,8,14,24] However, there was a discrepancy with the studies conducted in Rasht and Sistan.[2,3] The results of this study is based on adjusted model, there was no statistically significant relationship between the height of the newborn at birth and the incidence of MCAs, which was consistent with the study in Sistan.[2] Given that the measure of height and weight of newborn at birth are a result of the maternal nutrition during pregnancy, prenatal care, and supplementation, including folic acid, calcium, iron, and vitamins in prenatal care, the deficiency of nutrients during pregnancy can cause MCA and lead to insufficient growth of the newborn.[24-26]

This study indicated that the gestational age had a significant relationship with the incidence of MCAs. This finding is similar to the results obtained in the study of Rasht, Babol, Zanjan, and Egypt.[3,6,14,23]

Based on this study, there was a statistical significant relationship between place of residence and MCAs that was in discrepancy with the findings of the study in Zanjan.[6]

No significant relationship was found between MCAs and neonatal sex in this study. This finding is similar to the results of studies conducted in Rasht, Babil, Zanjan, Egypt, and Uganda[3,5,11,14,23] but different from the results of studies done in Hamedan, India, Sweden, and Tanzania.[4,8,17,24]

This study observed significant relationship between MCAs and pregnancy number, This finding is similar to the results obtained from Tanzania study.[24]

This study also showed that there was no significant difference between family marriage and MCAs. This finding is similar to the results of the studies conducted in Hamadan and Sistan[2,4] but different from the results obtained from the Egyptian study.[14]

The incidence of MCAs based on mother age did not differ significantly across among different age groups that was similar to the results of studies in Hamadan, Rasht, Babol, Zanjan, Gorgan, and Bandar Abbas and Uganda, Egypt, and Tanzania[3,4,6,11,14,20,22-24] but different from those of studies conducted in India and Sweden.[8,17]

Given that the data of this study were extracted from the medical file of pregnant mothers through the maternal and newborn system, there might be some missing mothers who did not deliver in the hospitals of the Chaharmahal and Bakhtiari Province, the lower counting of the data could be considered as one limitation of the study. Another limitation of the study is that the abnormal child might be classified as healthy infants because of the incorrect diagnosis.

Conclusion

Some of MCAs are so problematic that they can even lead to death but in some of them, early diagnosis and treatment can prevent early death or disability. Therefore, increasing awareness of the community especially women at gestational age regarding issues, such as appropriate gestational age, proper nutrition before and during pregnancy, and also the importance of prenatal care, is necessary to prevent CA.

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Conflicts of interest

There are no conflicts of interest.

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