

World Journal of *Obstetrics and Gynecology*

World J Obstet Gynecol 2017 May 10; 6(2): 8-15



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2017-2020

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ORIGINAL ARTICLE

Retrospective Cohort Study

- 8 Observed prevalence and risk factors of birth defects in Shanghai, China

Yang M, An XX, Wang HJ, Wang JM

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World Journal of Obstetrics and Gynecology
Volume 6 Number 2 May 10, 2017

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World Journal of Obstetrics and Gynecology (*World J Obstet Gynecol*, *WJOG*, online ISSN 2218-6220, DOI: 10.5317) is a peer-reviewed open access academic journal that aims to guide clinical practice and improve diagnostic and therapeutic skills of clinicians.

WJOG covers topics concerning pregnancy complications, obstetric surgical procedures, diagnostic imaging, endoscopy, reproductive endocrinology, tumors, pelvic diseases, evidence-based medicine, epidemiology and nursing.

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World Journal of Obstetrics and Gynecology is now indexed in China National Knowledge Infrastructure (CNKI).

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NAME OF JOURNAL

World Journal of Obstetrics and Gynecology

ISSN

ISSN 2218-6220 (online)

LAUNCH DATE

June 10, 2012

FREQUENCY

Quarterly

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World Journal of Obstetrics and Gynecology

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PUBLICATION DATE

May 10, 2017

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Retrospective Cohort Study

Observed prevalence and risk factors of birth defects in Shanghai, China

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0001-8283-3855); Ji-Mei Wang (0000-0002-3625-7145).

Author contributions: Yang M proposed the study and wrote
the first draft; An XX analyzed the data; Wang HJ collected the
data; Wang JM contributed to the design.

Institutional review board statement: The data used to fit
these models were obtained from the medical record system of
the Obstetrics and Gynecology Hospital of Fudan University.

Informed consent statement: All the participants for "birth
defect registration card" consent to take part in the study.

Conflict-of-interest statement: The authors declare that there
are no personal, organizational or financial conflicts of interest.

Data sharing statement: The data used in the study may be
requested from Ji-Mei Wang (wjm8219@163.com).

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Manuscript source: Invited manuscript

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Received: March 2, 2017

Peer-review started: March 2, 2017

First decision: March 28, 2017

Revised: April 15, 2017

Accepted: April 16, 2017

Article in press: April 16, 2017

Published online: May 10, 2017

Abstract

AIM

To investigate the prevalence and related risk factors of
birth defects in Shanghai.

METHODS

This report describes a population-based study of all
births at the Obstetrics and Gynecology Hospital of Fudan
University in Shanghai, China from January 2008 to
December 2014. A logistic regression analysis was used to
identify the parameters that are independently associated
with birth defects.

RESULTS

A total of 82814 births, including 824 cases of birth
defects, were recorded. The rate of birth defects was
0.995 per 100 births. In the multivariable regression
analysis, neonatal birth defects were likely to be
associated with higher gravidity [odds ratio (OR),
1.099, 95%CI: 1.024-1.178], premature birth (OR =
1.905, 95%CI: 1.501-2.418), low birth weight (OR =
3.844, 95%CI: 3.004-4.919), twin births or higher order
multiple pregnancies (OR = 1.477, 95%CI: 1.107-1.969),
cesarean delivery (OR = 1.184, 95%CI: 1.016-1.380) and
registration as part of a migrant population (OR = 1.380,
95%CI: 1.167-1.632). Female infants were less likely to
have birth defects than male infants (OR = 0.710, 95%CI:
0.616-0.818).

CONCLUSION

Higher gravidity, premature birth, lower birth weight,

twin births or higher order multiple pregnancies, and registration as part of a migrant population are independent predictors of birth defects.

Key words: Birth defects; Prevalence; Risk factors; Shanghai

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Core tip: We evaluated the prevalence and the related risk factors of birth defects in Shanghai. The ten most frequent birth defects in newborns each year were congenital heart defects, polydactyly and syndactyly, hypospadias, orofacial clefts, congenital ear malformation, Down syndrome, strephenopodia/strephexopodia, intestinal atresia/stenosis, chromosomal disorders, and kidney malformations. We also observed that higher gravidity, premature birth, lower birth weight, cesarean delivery, twin or multiple births and being a member of a migrant population are high risk factors of birth defects according to a large patient database.

Yang M, An XX, Wang HJ, Wang JM. Observed prevalence and risk factors of birth defects in Shanghai, China. *World J Obstet Gynecol* 2017; 6(2): 8-15 Available from: URL: <http://www.wjgnet.com/2218-6220/full/v6/i2/8.htm> DOI: <http://dx.doi.org/10.5317/wjog.v6.i2.8>

INTRODUCTION

Birth defects are defined as structural or functional anomalies (e.g., metabolic disorders) that occur during intrauterine life and that can be detected prenatally, at birth or later in life. As previously reported, birth defects, including congenital malformations (they form the exterior or microscopic structures within the abnormal fetus), mental retardation, and genetic chromosomal disorders, among others, are a major cause of pediatric morbidity and mortality and can occur in single or multiple organs^[1,2]. Improvement of antenatal diagnosis and electronic medical record systems allows reliable population-based studies that focus on congenital anomalies.

In the 1980s, China implemented a birth defect surveillance system. Approximately 470 hospitals in 31 provinces, municipalities and autonomous regions in the nation participate in this monitoring network; this three-level monitoring network covers nearly 80 million people. Based on continuous dynamic monitoring, we obtained accurate and reliable data that were vital to the health of Chinese women and their children, and provided a scientific basis for decision-making regarding maternal and neonatal health in our country. Located in Eastern China, Shanghai is the most economically developed metropolitan area and has participated in birth defect surveillance since 1986. To ensure the

accuracy of the surveillance information, information was directly transferred through the Internet. The objective of this study is to estimate the temporal trend and epidemiologic characteristics of birth defects at the Obstetrics and Gynecology Hospital of Fudan University in Shanghai from 2008 to 2014.

MATERIALS AND METHODS

Data sources and inclusion criteria

All the data in the investigation were obtained from the birth defect surveillance network of Obstetrics and Gynecology Hospital of Fudan University and were collected from 2008 to 2014. The anomalies were diagnosed prenatally, at birth or 7 d after delivery. According to the national hospital-based system that has been administered in China for more than 25 years, the birth population includes fetuses and neonates at 28 wk or more of gestation, including live births and still births, who are born in hospitals within the surveillance system^[3,4]. According to the requirements of the Chinese Birth Defects Program, the screening of perinatal infants for birth defects was conducted by two pediatric specialists. An interview of the mothers was conducted, and the "birth defect registration card" was completed after the clinical examinations. Furthermore, the well-trained professionals of the Maternal and Neonatal Health Care Institute in the area of our hospital verified the information on a quarterly basis, reviewed the medical records that pertained to the prenatal diagnosis (sonography, genetic tests or pathology) and coded all congenital anomalies. An assessment of birth defects was made according to the Tenth Revision of International Classification of Diseases (ICD-10).

Clinical investigations

Gastrointestinal malformations were diagnosed by gastrointestinal imaging or orthostatic abdominal film. Congenital heart defects (CHDs), kidney malformations, and hydrocephalus were assessed by ultrasonography during the fetal period and were confirmed after birth. Other birth defects, such as syndactyly, polydactyly, accessory auricle anomalies, orofacial clefts (OFCs), hypospadias and other visible birth defects were diagnosed based on the International Classification of Diseases (ICD-10). Prenatally diagnosed malformations were confirmed during the postnatal period before clinical symptoms were evident.

Statistical analysis

In this study, data on the ten most frequent congenital malformations in patients from the database who registered during 2008-2014 were selected for analysis. Only isolated congenital malformations were included according to the International Classification of Diseases (ICD-10). The *t*-test, ANOVA and χ^2 test were employed where applicable. In addition, a multiple logistic re-

Table 1 Ten most common birth defects and their prevalence rate at the Obstetrics and Gynecology Hospital of Fudan University, 2008-2014, *n* (%)

Birth defects	2008	2009	2010	2011	2012	2013	2014	Total (average prevalence)
Congenital heart disease	26 (0.394)	31 (0.470)	28 (0.286)	36 (0.280)	29 (0.196)	35 (0.232)	44 (0.470)	229 (0.277)
Polydactyly/syndactyly	17 (0.258)	27 (0.409)	21 (0.215)	35 (0.272)	36 (0.243)	41 (0.271)	41 (0.410)	218 (0.263)
Hypospadias	14 (0.212)	7 (0.106)	10 (0.102)	12 (0.093)	19 (0.128)	14 (0.093)	11 (0.106)	87 (0.105)
Orofacial clefts	4 (0.060)	11 (0.167)	13 (0.133)	5 (0.039)	14 (0.094)	15 (0.100)	17 (0.167)	79 (0.095)
Congenital ear malformations	3 (0.045)	9 (0.136)	17 (0.174)	13 (0.101)	6 (0.041)	6 (0.040)	5 (0.136)	59 (0.071)
Down syndrome	1 (0.015)	2 (0.030)	4 (0.041)	3 (0.023)	10 (0.067)	6 (0.040)	2 (0.030)	28 (0.034)
Strephenopodia/strephexopodia	1 (0.015)	5 (0.076)	9 (0.092)	3 (0.023)	2 (0.014)	3 (0.020)	1 (0.006)	24 (0.029)
intestinal atresia/stenosis	5 (0.076)	2 (0.030)	5 (0.051)	1 (0.008)	3 (0.020)	6 (0.040)	2 (0.012)	24 (0.029)
Chromosomal disease	5 (0.076)	0 (0)	1 (0.010)	1 (0.008)	0 (0)	5 (0.033)	4 (0.023)	15 (0.019)
kidney malformations	2 (0.030)	2 (0.030)	2 (0.020)	0 (0)	0 (0)	0 (0)	7 (0.041)	13 (0.016)
Number of births	6596	6602	9786	12844	14832	15110	17044	82814

gression analysis was performed to analyze the relationship between birth defects and potential risk factors. Confidence intervals were given, and a *P* value of < 0.05 was considered significant. All statistical analyses were conducted using SPSS version 13.0 (IBM Corp., Armonk, NY, United States).

RESULTS

Descriptive statistics

The mean age of women who were permanent residents at the time of childbirth was 29.05 ± 3.63 years of age, which was significantly higher than that of women in the migrant population (28.90 ± 4.54 years of age; $t = 3.58$, $P < 0.001$).

Of 824 cases with birth defects, 484 (58.7%) were male infants, 335 (40.7%) were female infants, and 5 (0.6%) were ambiguous in regard to sex. The male to female ratio was 1.44:1. Moreover, in the current study, 38236 cases (46.2%) were delivered vaginally, while the remainder (53.8%) were delivered by cesarean section. The average maternal age of women who underwent vaginal delivery was 28.42 ± 3.51 years, while that of women who underwent cesarean delivery was 29.55 ± 3.96 years ($t = 43.62$, $P < 0.001$). The frequency of cesarean sections increased with age ($\chi^2 = 1607.30$, $P < 0.001$).

Ten most frequent birth defects and their prevalence

From 2008 to 2014, 82576 live births and 238 stillbirths were recorded. Of them, 824 infants with congenital malformations accounted for a prevalence of 0.995 per 100 births (824/82814). In this study, the incidence of multiple birth defects concurrently present in a neonate was 7.3% (60/824). Among these infants with multiple congenital anomalies (MCA), the co-occurrence of anomalies may have been due either to chance (*i.e.*, unrelated etiologies) or a pathogenically associated pattern of anomalies^[5]. There were 42829 male infants (51.7%) and 39990 females (48.3%), and the overall ratio of male to female infants was 1.07:1.

The ten most frequent birth defects at the Obstetrics and Gynecology Hospital of Fudan University from

2008 to 2014 were listed according to the International Classification of Diseases (ICD-10). The three most frequent birth defects were CHDs (229), polydactyly or syndactyly (218) and hypospadias (87). The number of severe CHD cases declined annually. Cleft lip with palate, cleft lip alone and cleft palate alone accounted for 10 (2.7%), 16 (20.1%), and 53 (67.1%) of all OFC cases, respectively. Among the 218 perinatal cases of polydactyly/syndactyly, 152 occurred in the hands, 60 occurred in the feet, and 6 occurred in both (Table 1).

The ten most frequent birth defects of newborns annually were CHDs (0.277%), polydactyly and syndactyly (0.263%), hypospadias (0.105%), OFCs (0.095%), congenital ear malformations (0.071%), Down syndrome (0.034%), strephenopodia/strephexopodia (0.029%), intestinal atresia/stenosis (0.029%), chromosomal disorders (0.019%), and kidney malformations (0.016%). CHDs, intestinal atresia/stenosis, kidney malformations, hypospadias, OFCs, polydactyly and syndactyly, and accessory auricle anomalies have increased in the last six years, whereas the prevalence of Down syndrome has remained stable. Although the three major subtypes of neural tube defects (NTDs), namely, anencephaly, spina bifida, and encephalocele, were not among the ten most frequent birth defects, they have continued to decrease annually. In addition, congenital heart disease was the most frequent birth defect with a prevalence of 0.394% in 2008, 0.470% in 2009, 0.286% in 2010, 0.280% in 2011, and 0.470% in 2012. However, polydactyly/syndactyly had the highest prevalence in 2012 (0.243%) and 2013 (0.271%) (Table 1).

Multiple logistic regression

To analyze the relationship between the occurrence of birth defects and potential risk factors, a multiple logistic regression model was applied. In this model, the variables were listed as follows: Maternal age (< 20, 20-24, 25-29, 30-34, 35-39, ≥ 40), parity (first, second, third, and fourth or more pregnancy), gestation (first, second, third, and fourth or more pregnancy), sex of the infant (male, female), gestational age (≥ 37 wk, < 37 wk), birth weight (normal, extremely low birth weight (ELBW), very low birth weight (VLBW) and low

Table 2 Multiple logistic regression of risk factors for birth defects, 2008-2014

Factors	Delivery	Cases (%)	OR (95%CI) Enter	P value
Maternal age (yr)				
< 20	274	2 (0.7)	1	-
20-	7353	82 (1.1)	1.951 (0.473, 8.045)	-
25-	41861	392 (0.9)	1.818 (0.446, 7.406)	-
30-	26285	249 (0.9)	1.686 (0.413, 6.886)	-
35-	6080	74 (1.2)	1.806 (0.435, 7.494)	-
40-	961	20 (2.1)	2.676 (0.611, 11.715)	-
Parity order	-	-	0.835 (0.687, 1.014)	0.069
Gravidity order	-	-	1.099 (1.024, 1.178)	0.009
Gender				
Male	42828	484 (1.1)	1	
Female	39986	335 (0.8)	0.710 (0.616, 0.818)	< 0.001
Gestational age (wk)				
≥ 37	75750	556 (0.7)	1	
28-37	7064	263 (3.7)	1.905 (1.501, 2.418)	< 0.001
Birth weight				
Normal	73133	536 (0.7)	1	
ELBW and VLBW and LBW	4742	242 (5.1)	3.844 (3.004, 4.919)	< 0.001
Macrosomia	4939	41 (0.8)	1.090 (0.790, 1.503)	0.601
Plurality				
Singletons	79440	691 (0.9)	1	
Twins or higher order multiple pregnancies	3374	128 (3.8)	1.477 (1.107, 1.969)	0.008
Household registration				
Permanent population	68930	617 (0.9)	1	
Migrant population	13884	202 (1.5)	1.380 (1.167, 1.632)	< 0.001
Delivery mode				
Vaginal delivery	38236	291 (0.8)	1	
Cesarean delivery	44578	528 (1.2)	1.184 (1.016, 1.380)	0.031

ELBW: Extremely low birth weight; VLBW: Very low birth weight; LBW: Low birth weight.

birth weight (LBW), macrosomia), number of fetuses (single, twins, and multiple births), delivery mode (vaginal delivery, cesarean delivery) and household registration (permanent population, migrant population). The analysis suggested that higher gravidity [odds ratio (OR) = 1.099, 95%CI: 1.024-1.178], premature birth (OR = 1.905, 95%CI: 1.501-2.418), low birth weight (OR = 3.844, 95%CI: 3.004-4.919), twins or multiple pregnancies (OR = 1.477, 95%CI: 1.107-1.969), cesarean delivery (OR = 1.184, 95%CI: 1.016-1.380) and registration as part of a migrant population (OR = 1.380, 95%CI: 1.167-1.632) were significantly associated with birth defects. Female infants were less likely to have birth defects (OR = 0.710, 95%CI: 0.616-0.818) (Table 2).

DISCUSSION

Compared with previous reports, a larger sample analysis was used here to estimate the epidemiologic characteristics of birth defects, and a multivariate analysis was applied to explore the associations between possible risk factors and birth defects. The incidences of birth defects in Shanghai in 2011, 2012, 2013, were 1.17%, 1.05% and 0.98%, respectively, which are relatively lower than the national average prevalence (1.10-1.45 per 100 births)^[2]. These results could be attributed to the salubrious climate, availability of rich and diverse fresh fruit, and more developed economic

and advanced health technologies, which benefitted the health of pregnant women and their fetuses in Shanghai. The rate of birth defects at our hospital was 0.995 per 100 births, which was in agreement with the overall rate in Shanghai^[6]. The incidence of birth defects in eastern areas was higher than that in middle and western areas within China in 2014^[6]. Pregnant women in Shanghai regularly participate in prenatal screenings and are likely to maintain the pregnancy unless serious diseases such as very severe heart defects and multiple malformations are present, which leads to fewer terminations of pregnancy in Shanghai than in other areas.

Birth defects have already become the primary cause of neonatal mortality and morbidity, and could also be an important source of distress for parents and families. Our hospital regularly monitors women with gestational diabetes and hypertensive disorders. Our hospital also focuses on screening for major malformations during the first trimester by ultrasound and the monitoring of fetal growth to find potential anomalies. Additionally, the use of invasive prenatal diagnostic techniques including amniocentesis, chorionic villus sampling (CVS), fetal blood sampling and embryoscopy, help in the identification of anomalies. Therefore, the Chinese government has abolished intervention using the three-step-prevention mode to improve the physical quality of newborns. With innovations in the quality and accessibility of diagnostic tests, increasing numbers of

birth defects are diagnosed^[7].

The prevalence of CHDs and polydactyly/syndactyly in Shanghai was 0.277 per 100 and 0.263 per 100, respectively, which was higher than the prevalence in Inner Mongolia (0.171 per 100 and 0.085 per 100, respectively)^[8]. CHDs were the most frequent anomalies in our study, and their prevalence was lower in Shanghai than in all of China (32.74-43.22 per 10000 live births)^[2]. According to previous reports, compared with other races, in Asians, CHDs ranked as the most frequent among general birth defects, with a higher incidence of pulmonary stenosis (PS) and tetralogy of Fallot (TOF), but a lower incidence of left-sided obstructions, transposition of the great arteries (TGA), and tricuspid atresia^[9]. Since 2007, CHDs have been reported as the most frequent birth defects in China^[2]. This might be attributed to the popularization of prenatal diagnosis and postpartum echocardiographic screening^[2]. The prevalence of polydactyly/syndactyly, hypospadias, cleft lip and palate and accessory auricle anomalies was increased in our study. This may be due to environmental factors, IVF (*in vitro* fertilization) or ICSI (intracytoplasmic sperm injection). Since the time the first infant was born as a result of ART in China in 1988, more and more infants have been born after use of ART^[10]. Compared with births after spontaneous conception, births resulting from IVF and ICSI combined were found to be associated with a significantly increased risk of any birth defect (unadjusted odds ratio, 1.43; 95%CI: 1.26-1.62)^[11]. Moreover, anomalies of the limbs, face, and genitourinary system (34%) were found to be associated with the lowest detection rate by ultrasonography^[12], and thus polydactyly/syndactyly, hypospadias, cleft lip and palate, and accessory auricle anomalies were difficult to detect by prenatal screening and diagnostic methods.

Specifically, the earliest reports of NTDs (neural tube defects) in China showed an overall prevalence of 27.4 per 10000 in 1986 and 1987, while in our study, the prevalence was lower; therefore, NTDs were not among the 10 most common birth defects (0.01 per 100 individuals). Moreover, the rate of NTDs was also lower than that in Mongolia (0.201 per 100 individuals)^[8]. This decrease is due to the nationwide availability of complementary folic acid supplements as of 2009^[13,14] and prenatal ultrasound screening. Early interventions, such as induced abortion, would be performed if neural tube defects were detected by clinical and ultrasound tests.

In our study, the overall ratio of male to female infants with birth defects was 1.44:1. The incidence of birth defects in male infants was higher than that in female infants, which was consistent with national survey results^[2,7]. Therefore, the birth defects in male infants may account for more in the whole population. This may be due to differences in hormone levels or because the Y chromosome has a higher susceptibility to damage than the X chromosome^[15]. In addition,

external genital deformities in females were less likely to be found than those in males. However, earlier abortions of female fetuses may have affected the sex ratio. Combined with the one-child policy, the traditional preference for male infants in China has resulted in widespread abortions of female fetuses^[16].

The prevalence of birth defects in preterm infants was significantly higher than that in term infants, which paralleled what has been found in other populations. A possible explanation for this result might be that birth defects in premature infants were associated with maternal health, nutrition, older maternal age, hypertension, diabetes and drug use, among other factors, during pregnancy. Previous reports revealed that the most common birth defects were intestinal atresia, gastroschisis deformity, and esophageal atresia, especially in premature babies of gestational age 24 to 28 wk^[17].

The incidence of birth defects in newborns with low birth weight was much higher than that in those with normal birth weight or macrosomia, which was consistent with the results of a previous study. In recent years, the number of elderly parturient women (older than 35 years) has increased from 562 cases in 2008 to 1562 cases in 2014. In a previous study, gastroschisis, cleft lip and palate, Down syndrome and other chromosomal diseases were found to be associated with the age of the mothers, and older mothers were at a higher risk of premature labor and pregnancy complications^[18]. Several studies found that maternal age < 20 or > 35 years was a risk factor for birth defects^[8,19] because the eggs of women younger than 20 years were not fully mature, whereas ovarian function and egg quality in women older than 35 years were poor. However, the results of one study indicated that the increased risk related to maternal age was negligible, especially when compared with the occurrence of chromosomal abnormalities^[20]. Nonchromosomal abnormalities are common in Europeans, and the lowest prevalence is observed in mothers aged between 30 and 34 years^[21]. Advanced maternal age (over 35 years of age) was found to be related to a higher prevalence of birth defects, but no significant difference was found between these women and younger women^[22]. Based on this result, antenatal care and prenatal screening should be directed to pregnant women over 35 years of age. Furthermore, with the promotion of "two children for one family", which has been the national policy since 2014, the proportion of older mothers is expected to increase; this in turn will bring great challenges to the prevention and treatment of birth defects.

The mean age of women who were permanent residents at the time of childbirth was significantly higher than that of women in the migrant population. Women in the migrant population came to Shanghai from other areas within six months before pregnancy. This population includes older mothers with pregnancy-

associated diseases and temporary workers. Therefore, we observed a higher risk of birth defects in the migrant population than in the permanent resident population, and several possible explanations for this are discussed below. First, living conditions and occupational exposure might be more serious for these women, and they may more easily encounter substances that may not be present in urban areas such as mercury, lead, inhalable particles, and organic solvents, which are related to birth defects. Previous reports indicated a correlation between maternal agricultural work and birth defects^[23]. Second, most migrants, including factory workers, builders and those in other vulnerable occupations, might be less educated and unaware of the importance of maternal health^[24]. The severe perinatal complications in most migrant women were possibly due to their temporary move to Shanghai in order to give birth at a tertiary center, rather than at a rural hospital, where it is safer for mothers and fetuses. Higher capabilities of healthcare personnel and better living environments contribute to improved maternal health knowledge scores, and thus more women with high-risk pregnancies were included in the migrant population^[25]. Furthermore, migrant women and permanent residents may have different lifestyles, habits or nutrition supplements^[8]. For example, the benefits of multi-vitamin supplements during pregnancy may be insufficiently promoted among migrant populations. A previous study showed that multivitamin and folic acid supplementation before the pregnancy could reduce the overall occurrence of congenital abnormalities and neural-tube defects^[26]. Moreover, the public health system bears the consequences of political and economic decisions made elsewhere in society, and this is especially prominent in cities with large populations like Shanghai^[27]. The current study reported that permanent residents have a lower risk of birth defects, but this finding requires further investigation of the influence of genetic, cultural and environmental factors on birth defects. In the entire migrant population, the proportion of women aged < 20, ≥ 20 but < 25, ≥ 25 but < 35 and ≥ 35 was 1.0%, 14.9%, 9.5%, and 2.0%, respectively, which was higher than the corresponding proportion of all permanent residents in these age groups (0.2%, 7.7%, 6.9%, 1.0%, respectively).

The main findings of this study are consistent with those of previous studies, but other important results were also obtained, as described below. In our analysis, the prevalence of birth defects in caesarean deliveries was higher than that in vaginal deliveries during the same period. This might be due to larger fetuses, abnormal umbilical cords, and amnion or intrauterine infections, which negatively affect the health of the fetuses. The incidence of birth defects in twins and other types of multiple births was higher than that in singleton births.

In summary, birth defects are generally caused by several interrelated factors. Risk factors that contribute to birth defects include genetics, exposure to chemicals, physical and biological issues and maternal elements.

More than half of all birth defects cannot be attributed to a single factor^[28]. It is thus a good idea to apply more complete prenatal examinations as well as to pay more attention to maternal health care and prenatal nutrition. To better understand the serial occurrence of birth defects in China, more hospitals should participate in this health network and launch nationwide multi-center studies. It is necessary to implement unified criteria and regular professional training for the diagnosis of birth defects, as well as to review the current knowledge of birth defects and promote more advanced technologies.

However, several limitations prohibited further analysis. First, this study was conducted by two departments at our hospital, and the results may not be generalizable to the Shanghai area. Second, the prevalence was not applicable to births < 28 wk of gestation. However, the numbers of births before 28 wk of gestation are much smaller compared with the number of births after 28 wk of gestation. Therefore, the impact of these births on the prenatal and perinatal prevalence of birth defects is expected to be minimal. This should, however, be further investigated in a future study. The individuals who manage the medical records of our hospital were contacted about the rate of induced termination of pregnancies due to prenatally diagnosed fetal anomalies, but these data were unavailable; this information would definitely alter the prevalence of defects diagnosed postnatally.

The current study used a large database to analyze neonatal congenital malformations and related risk factors. We found that higher gravidity, premature birth, lower birth weight, cesarean delivery, twin or multiple births and registration as part of a migrant population are high-risk factors for birth defects. Based on this result, the recommended interventions are as follows: (1) regular screening tests among pregnant women are needed at local health care sectors in Shanghai; and (2) despite the difficulty, the primary emphasis should be to enhance the management (provide more knowledge and training for pregnant women during the prenatal period) and health care (such as folic acid supplementation) of women in migrant populations in the future.

ARTICLE HIGHLIGHTS

Research background

In the 1980s, China implemented a birth defect surveillance system. Approximately 470 hospitals in 31 provinces, municipalities and autonomous regions in the nation participate in this monitoring network; this three-level monitoring network covers nearly 80 million people.

Research motivation

Based on continuous dynamic monitoring, the authors obtained accurate and reliable data that were vital to the health of Chinese women and their children, and provided a scientific basis for decision-making regarding maternal and neonatal health in the author's country.

Research objectives

The objective of this study is to estimate the temporal trend and epidemiologic

characteristics of birth defects at the Obstetrics and Gynecology Hospital of Fudan University in Shanghai from 2008 to 2014.

Research methods

This report describes a population-based study of all births at the Obstetrics and Gynecology Hospital of Fudan University in Shanghai, China from January 2008 to December 2014. A logistic regression analysis was used to identify the parameters that are independently associated with birth defects.

Research results

A total of 82814 births, including 824 cases of birth defects, were recorded. The rate of birth defects was 0.995 per 100 births. In the multivariable regression analysis, neonatal birth defects were likely to be associated with higher gravidity (OR = 1.099, 95%CI: 1.024-1.178), premature birth (OR = 1.905, 95%CI: 1.501-2.418), low birth weight (OR = 3.844, 95%CI: 3.004-4.919), twin births or higher order multiple pregnancies (OR = 1.477, 95%CI: 1.107-1.969), cesarean delivery (OR = 1.184, 95%CI: 1.016-1.380) and registration as part of a migrant population (OR = 1.380, 95%CI: 1.167-1.632). Female infants were less likely to have birth defects than male infants (OR = 0.710, 95%CI: 0.616-0.818).

Research conclusions

Higher gravidity, premature birth, lower birth weight, twin births or higher order multiple pregnancies, and registration as part of a migrant population are independent predictors of birth defects.

Research perspectives

Based on this result, the recommended interventions are as follows: (1) regular screening tests among pregnant women are needed at local health care sectors in Shanghai; and (2) despite the difficulty, the primary emphasis should be to enhance the management (provide more knowledge and training for pregnant women during the prenatal period) and health care (such as folic acid supplementation) of women in migrant populations in the future.

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P- Reviewer: Khajehei M, Partsinevelos G, Schulten HJ, Zafrakas M

S- Editor: Ji FF **L- Editor:** A **E- Editor:** Lu YJ





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