Maternal, Fetal, and Delivery Risk Factors for Stillbirth: A Population-Based Study

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Abstract

Background: One of the most important indices of health planning and policymaking in every country is the distribution and leading causes of mortality.

Objectives: This study was conducted to determine the prevalence of stillbirth and it's maternal, fetal, and delivery risk factors in Zanjan province during 2014 - 2015.

Methods: The study was descriptive-analytical research. The electronic birth registration form, which is used to collect delivery data in Iran, was used for data collection. Data were analyzed using descriptive, univariate, and multivariate regression tests.

Results: The incidence of stillbirth was 10 per 1000 births and consistent with the country's rate. There was a significant correlation between stillbirth and gestational age, birth weight, anomalies, vaginal delivery, outside hospital delivery, delivery complications, episiotomy, and labor induction and augmentation.

Conclusions: It seems that changing modifiable factors such as the place of delivery, type of delivery, and labor interventions can prevent stillbirth more effectively.

Keywords: Prevalence, Risk Factors, Stillbirth, Zanjan

1. Background

There are different definitions about stillbirth or intrauterine fetal death (IUFD) based on gestational age, birth weight, and birth height in different guidelines (1). According to the Iranian Ministry of Health and Medical Education, stillbirth is defined as the fetal death after 24 weeks of gestation (2). In 2015, about 2.6 million babies were born dead worldwide. Most of the mortalities happen in developing countries with average income. Stillbirth imposes a heavy burden not only on the health system but also on the mother and her family (3). One of the functional goals of the World Health Organization (WHO) is to reduce the prevalence of stillbirth to 12 cases or fewer per 1000 births until 2030 (4). There are considerable differences in the prevalence of stillbirth between developing and developed countries. The rate of mortality in the world is significantly different from 3.4 per 1000 births in developed countries to 28.7 per 1000 births in sub-Saharan Africa (5). Stillbirth in Iran has a high prevalence in low socioeconomic groups (6). However, limited studies have been conducted on the prevalence of stillbirth in Iran (7-9). According to the authors' literature search, there was no study on the prevalence of stillbirth in Zanjan.

One important indicator of health in each society is the rate of mortality in different populations, especially individuals around birth and infancy. Distribution and risk factors of mortality are essential for health planning and policymaking. Many studies have been conducted on the risk factors of stillbirth (6, 10, 11). Epidemiologic studies can never prove whether these risk factors are the causes of stillbirth. They only show that there is an association between risk factors and stillbirth (12). Mortality has multifactorial nature and individual factors interact with the overall risk of stillbirth. Factors that cause intrauterine growth restriction and preterm labor may ultimately lead to stillbirth. Identifying modifiable risk factors of stillbirth that can threaten the health of mothers and children is very important and can help put an end to preventable deaths (11). Preventive measures of stillbirth are specific in each society and should be investigated and reported separately based on the risk factors of the outcome (13).

2. Objectives

Considering the lack of any study on the prevalence of stillbirth in Zanjan and in view of the importance of studying the index of stillbirth, this study was conducted to determine the prevalence of stillbirth and it's maternal, fetal, and delivery risk factors in Zanjan province during 2014 - 2015.

3. Methods

The study was descriptive-analytical research. Based on the definition of stillbirth in Iran, all live births and stillbirths after 24 weeks of gestational age were assessed, including 41265 deliveries during 2014 - 2015 in Zanjan province. The births' data were collected from the Iranian Mother and Newborn (IMAN) web system report of private and government maternity hospitals of Zanjan province. The data from deliveries in the hospitals of Zanjan city and other cities including Abhar, Khorram Darreh, Tarom, Mahneshan, Iijrod, Khodabandeh, and Soltanieh, as well as outside-hospital delivery data occurring in delivery facilities, at home, or on the way of the hospital, were considered in the study. All of the birth data had been registered by trained staff in the IMAN web site. This system was designed by the Iranian Ministry of Health and Medical Education as an important source for collecting data and evaluating the health status of mothers and newborns in Iran. This system has been established since 2013. From 2014, online data collection has been done using an electronic registration form. The form consists of three parts. The first part is related to maternal characteristics including age, nationality, level of education, place of residence, place of delivery, consanguinity with the spouse, maternal risk factors, delivery complications, obstetric interventions, maternal outcomes two hours after delivery, type of delivery, reasons for cesarean delivery, birth attendant, and type of insurance. The second part is related to neonatal characteristics including gestational age, resuscitation, first and fifth-minute APGAR scores, congenital malformations, and newborn outcome after delivery. The last part is related to the characteristics of stillbirth including the day of death, the time of death, and fetus or newborn diseases at the death time. All data were obtained from the Iranian Ministry of Health experts in the Excel format that entered into the SPSS version 16 software by the researchers. The full coverage of birth registration was verified by comparing the maternal and newborn data recorded in the registration system with the provincial birth statistics in 2014 - 2015, which were reported by the provincial civil registration office. In order to ensure the accuracy of the data entry, some

of the entered data in the software were controlled by the provincial data randomly.

For data analysis, the required variables were defined. The stillbirth prevalence and factors that could be associated with stillbirth were determined descriptively. The results were presented as numbers, percentages, means, and standard deviations. The relationship between independent variables and stillbirth was determined by univariate and multivariate logistic regression models using a backward LR method. Maternal age, maternal education, type of insurance, place of residence, gravida, abortion, birth weight, place of delivery, type of delivery, complications of delivery, presence of risk factors in pregnancy, episiotomy, labor induction and augmentation, delivery with forceps or vacuum, sex of newborn, and congenital anomalies were entered into the final regression model. These variables determined 58.6% of stillbirth variances. All P values of < 0.05 were considered statistically significant. The protocol of the study was approved by the Ethics Committee of "institute removed for blank review" by grant number ZUMS.REC.1395.56.

4. Results

The mean (SD) of mothers age was 27.78 (6.13) years. Most of the mothers lived in urban areas (60.8%) and had insurance coverage (97.3%). In 11.4% of the cases existed parental consanguinity. Most of the newborns (99.9%) were born in Zanjan hospitals (Table 1).

Totally, 41265 cases of delivery occurred in Zanjan province during 2015 - 2016, of which 396 were stillbirths. Therefore, the incidence of stillbirths was estimated to be 1% or 10 per 1000 births. Univariate logistic regression showed that there was a statistically significant relationship between stillbirth and maternal age, maternal education, maternal underlying illness, eclampsia or preeclampsia and other diseases, abortion, gestational age, birth weight, congenital anomalies, sex, delivery place, type of delivery, complications of maternal delivery, blood and blood products transfusion, episiotomy, and labor induction and augmentation (All P values < 0.05) (Table 1).

The results of multivariate regression analysis after adjusting for maternal age, maternal education, insurance status, place of residence, gravida, abortion, mothers underlying diseases, delivery with forceps or vacuums, and sex showed that every one-week increase in gestational age decreased the odds of stillbirth by 0.796 times (95% CI: 0.736 - 0.861; P < 0.001) and every one-gram increase in birth weight decreased it by 0.999 times (95% CI: 0.998 - 0.9999; P < 0.001). Congenital anomalies increased the chance of stillbirth by 8.731 times (95% CI: 4.228 - 18.027; P < 0.001). Women with normal vaginal delivery were 2.797

Table 1. Maternal Characteristics and Factors Related to Stillbirth Based on Univariate Regression

Variable	Number	Percentage	Odds Ratio	95% CI	P Value
Year					
2014	20236	49	0.958	1	
2015	21029	51	1	0.786, 1.168	0.672
Maternal age[a]	27.7	6.1	1.022	1.006, 1.038	0.008
Maternal education					
Illiterate	1274	3.1	1		
Elementary school	9149	22.2	0.597	0.374, 0.953	0.031
Guidance and high school	9609	23.3	0.556	0.348, 0.888	0.014
Diploma	13380	32.4	0.472	0.297, 0.748	0.001
University	7521	3.1	0.542	0.335, 0.878	0.013
Ph.D	80	0.2	2.217	0.649, 7.571	0.204
Others	252	0.6	0.455	0.106, 1.948	0.289
Consanguinity with the spouse (yes)	4702	11.4	1.125	0.835, 1.516	0.439
Place of residence (urban)	25070	60.8	1.224	0.994, 1.506	0.057
Insurance					
Urban Medical Services	1934	4.7	1.080	0.574, 2.031	0.811
Rural Medical Services	7058	17.1	0.588	0.331, 1.043	0.070
Social Security Organization	11202	27.1	0.676	0.392, 1.166	0.159
Others[b]	2602	6.3	0.858	0.460, 1.600	0.630
Relief Foundation or none	1158	27	1		
Mother's underlying illness (yes)	5097	12.3	1.695	1.318, 2.181	< 0.001
Gravid[a, c]	2.0	1.0	1.076	0.987, 1.173	0.096
Para[a]	0.8	0.9	0.955	0.855, 1.068	0.424
Abortion[a]	0.2	0.5	1.419	1.235, 1.630	< 0.001
Gestational age[a]	38.4	2.0	0.626	0.613, 0.640	< 0.001
Birth weight[a]	3144.7	531.5	0.997	0.997, 0.998	< 0.001
Congenital anomalies (yes)	305	0.7	23.638	17.184, 32.515	< 0.001
Sex					
Male	21165	51.3	0.020	0.008, 0.049	< 0.001
Female	20078	48.7	0.021	0.008, 0.052	< 0.001
Unknown	22	0.1	1		
Place of delivery					
Hospital	41204	99.9	1		
Outside hospital[d]	43	0.1	10.678	3.798, 30.024	< 0.001
Delivery type (vaginal)	24666	59.8	3.105	2.400, 4.017	< 0.001
Delivery complication (yes)	268	0.6	0.357	0.167, 0.761	0.008
Interventions during delivery					
Episiotomy	8055	19.5	4.158	2.703, 6.397	< 0.001
Induction	5113	12.3	0.253	0.205, 0.311	< 0.001
Augmentation	9075	21.9	1.833	1.371, 2.450	< 0.001
Forceps or vacuum delivery	498	1.2	0	0	0

[a] Mean ± standard deviation.
[b] Armed Forces Insurance, Petroleum Industry Staff Insurance, and Banking System Staff Insurance.
[c] Delivery facilities.
[d] At home, or on the way of hospital.

times more likely to have stillbirth compared to women with cesarean section (95% CI: 1.792 - 4.363; P < 0.001). Out-side hospital delivery increased the probability of stillbirth by 13.133 times (95% CI: 1,787 - 7,597; P = 0.011). Maternal com-

plications during labor reduced the chance of stillbirth by 0.278 times (95% CI: 0.079 - 0.976; P = 0.046). In addition, episiotomy reduced the chance of stillbirth by 0.302 times (95% CI: 0.154 - 0.593; P = 0.001) and induction and augmentation increased it by 4.198 (95% CI: 2.699 - 6.567; P < 0.001) and 2.046 times (95% CI: 1.192 - 3.514; P = 0.009), respectively (Table 2).

5. Discussion

The results of the study showed that the stillbirth rate in Zanjan was 1% (10 per 1000 births). In addition, there was a significant relationship between stillbirth and gestational age, birth weight, anomaly, type of delivery, place of delivery, complications of childbirth, episiotomy, induction, and augmentation of labor.

The prevalence of stillbirth was 1%. The prevalence of stillbirth is reported very differently in the world. It was reported to be 4% in England (10), 0.4% in Canada (14), and 4.9% in India (12). Quibel et al. (15) in a systematic review showed that the stillbirth rate is 2% in the world. In addition, there are different reports on the prevalence of stillbirth in different cities of Iran. The prevalence of stillbirth was 11.7 in Babol (7), 19.8 in Arak (16), 40 in Ahwaz (9), and 88.7 in Zahedan (per 1000 births) (8). The estimated prevalence of stillbirths in this study was very close to the national estimated rate (13). Reaching a zero prevalence rate of stillbirth will require complex planning and policymaking. Moreover, it is possible that some birth events in the province have not been registered. Reports show that in some countries, only are two-thirds of births registered, and only are 5% of the neonatal deaths reported. Thus, stillbirth reporting maybe even less than 5%. Reporting and recording all stillbirths, maternal, and neonate deaths will increase data access in the health system. Data recovery alone does not prevent death, but it provides a way to target interventions to reach about 7,000 women who experience stillbirth every day (11).

Among the fetal factors, gestational age, birth weight, and presence of abnormalities were significantly related to stillbirth. Disorders that disturb the function of the placenta, such as intrauterine growth retardation, preterm labor, or both, are counted as the repetitive causes of stillbirth (11). The study also showed that the chance of stillbirth reduced with increasing gestational age and birth weight. These results are consistent with the results of previous studies (8, 10, 17). Congenital malformation increased the incidence of stillbirth by about nine times, which is consistent with the results of Walfisch et al. study (14). Birth abnormalities account for about 7.4% of all stillbirths (11). It seems that improving the quality of preconception care, controlling risk factors, and performing pre-

natal screening tests during prenatal care, and improving care during delivery could prevent stillbirth.

Stillbirth was much higher in deliveries that happened in delivery facilities, home, or on the way of hospital compared to deliveries happening in the hospital. Homebirth requires qualified midwives in childbirth, newborn and maternal rehabilitation, and appropriate referral systems for emergencies; otherwise, an increased risk of stillbirth is expected in mothers who give birth outside the hospital. In addition, the prevalence of stillbirth was about three times higher in normal vaginal delivery than in cesarean delivery, which is expected due to the rationale and preferred choice of normal vaginal delivery in the cases of stillbirth.

Higher odds of stillbirth in delivery interventions, such as labor induction and augmentation, and lower odds of stillbirth in episiotomy and delivery complications were expected. However, it is not possible to judge certainly whether stillbirth leads to these interventions or vice versa. However, previous studies have shown that in appropriate cases, labor induction at the right time can prevent fetal mortality (18) and in the cases of stillbirth, these interventions are essential for termination of pregnancy (19). Improving birth care could prevent about 1.3 million stillbirths and avoidable deaths for mother and newborn (11). The authors suggest that the effect of childbirth interventions on stillbirth be examined in a prospective study.

The factors found in this study could predict about 60% of stillbirth's variances, which is a strength of this study and suggests that planning for modifiable factors in this study could prevent stillbirth effectively. Abnormalities, the place of delivery, the type of delivery, induction, and augmentation of labor were modifiable factors in this study. Stillbirth may be prevented by preconception counseling, effective screening during pregnancy, encouraging women for timely hospital admission, delivery at the hospital or by a trained midwife, if outside the hospital, and labor induction and augmentation just in necessary and advised conditions.

5.1. Future Research Implications

The prevalence of stillbirth in the present study was near to the reported prevalence of the country, and there was a significant relationship between stillbirth and factors such as gestational age, birth weight, place of delivery, type of delivery, and labor induction and augmentation. It seems that with the improvement of preconception care and screening programs, delivery in the hospital, labor interventions only if necessary and recommended, a stillbirth can be more prevented. In addition, by revising the questionnaire, evaluating the data, and educating the recorder staff, the data can be used more effectively.

Table 2. Factors Related to Stillbirth Based on Multivariate Regression

Variable	Odds Ratio[a]	95% CI	P Value
Gestational age	0.796	0.736, 0.861	< 0.001
Birth weight	0.999	0.998, 0.999	< 0.001
Congenital anomalies (yes)	8.731	4.228, 18.027	< 0.001
Delivery type (vaginal delivery)	2.797	1.792, 4.363	< 0.001
Delivery place			
Hospital	1		
Outside hospital[b]	13.133	1.787, 96.512	0.011
Delivery complications (yes)	0.278	0.079, 0.976	0.046
Interventions during delivery			
Episiotomy	0.302	0.154, 0.593	0.001
Induction	4.198	2.699, 6.527	< 0.001
Augmentation	2.046	1.192, 3.514	0.009

[a] Adjusted for maternal age, maternal education, type of insurance, place of residence, gravida, abortion, mother's underlying illness, forceps or vacuum delivery, and sex.
[b] Delivery facilities, at home, or on the way of hospital.

5.2. Limitations

The limitations of this study may include the lack of equal precision of the medical recorders in the files or in the data registration system, the lack of data collection specifically for the study, and therefore the lack of data accuracy and even their incompleteness. On the other hand, the chronological order of the variables was not known. Therefore, it is suggested that the questionnaire used for the birth registration system be edited and some variables such as the fetal heart rate at the time of admission to the hospital be recorded. It is also suggested that the recording staff be educated and the validity of the data be evaluated periodically.

Acknowledgments

Footnotes

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