



The Correlation Between Stillbirth and Related Risk Factors: A Case-Control Study

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Abstract

Background: Stillbirth is one of the unfavorable consequences of pregnancy. Generally, the true causes of fetal death are complicated and difficult to accurately identify.

Objectives: The present study was aimed to identify risk factors for stillbirth among mothers referring to health centers of Hormozgan province, Iran.

Methods: This case-control study was conducted in 12 cities of Hormozgan province in 2015. The samples were randomly selected among those referring to the health centers of Hormozgan province by cluster sampling. Required data were collected by using a researcher-made questionnaire comprised of demographic characteristics of the mother pregnancy and delivery. The univariate and multivariate logistic regression analyses were used to measure the correlation between variables within a significance level of 5%. Data analysis was performed using SPSS, version 21.

Results: A total of 825 mothers were recruited and assigned into two groups, experimental and control groups. There were 403 mothers with a history of stillbirth in the experimental group, and the control group was comprised of 422 mothers with a healthy live birth. The average age of the participants in the experimental and control groups were 27.68 ± 6.4 and 26.96 ± 5.4 years, respectively. Most of the mothers (> 90%) in both groups were housewives and most mothers in the case group (37%) were illiterate, whereas the majority of controls (43%) had a university education. The odds of stillbirth among mothers older than 35 years was 2.33 times higher than other mothers [OR: 2.33, 95% CI (1.287 - 4.246)]. The odds of stillbirth among mothers with a history of stillbirth was 10 times higher than those with no stillbirth history [OR: 10.1, 95% CI (2.846 - 35.973)].

Conclusions: The findings of this paper show that the fetal death is associated with maternal age, maternal education, maternal area of living, history of stillbirth in previous pregnancies and history of abortion in previous pregnancies. The results of this study may help to conduct future research effectively, and help supervisors and policymakers make evidence-based operational decisions.

Keywords: Stillbirth, Risk Factors, Pregnancy, Hormozgan

1. Background

More than 30% of pregnancies lead to an inevitably fetal death (1). Stillbirth is one of the most common adverse outcomes of pregnancy. More than 3.2 million cases of stillbirth occur worldwide every year (2) and approximately 99% of stillbirth occur in low- or average-income countries, with the highest prevalence in South Asia (3, 4).

Although stillbirth is one of the major adverse outcomes of pregnancy, it is often not well-reported. Thus, the cause of stillbirth is almost unclear, and there is no univer-

sally accepted definition for this condition (4). The World Health Organization recommends that stillbirth or fetal death is restricted to fetal deaths with a birthweight ≥ 500 g. In addition, if birthweight is unavailable, after 22 completed weeks of gestation or with a crown, the heel length of ≥ 25 cm is considered (5).

The cause of fetal death is very complex due to the presence of many contributing and interacting factors. In addition, certain conditions may be associated with stillbirth such as diabetes mellitus, without directly causing them.

Therefore, it is difficult to determine the exact cause of many stillbirths (6). Congenital abnormalities, placental abruption, and uterine infections have been shown to be associated with increased risk of stillbirth. According to the literature related to the prevalence of stillbirth, these factors may also increase the likelihood of other side effects, including the risk of preterm delivery and small-for-gestational-age births (7). Generally, women with the history of stillbirth are likely to be at 2- to 10-fold increased risk of recurrence for stillbirth (2, 7, 8).

In 2015, there were 2.6 million stillbirths globally, with the majority of deaths occurring in developing countries. In addition, about half of all stillbirths were reported during labor. Three fourth of stillbirths occurred amongst families living in South Asia or sub-Saharan countries, of whom 60% were living in rural areas (6). In many high-income countries, stillbirth is less than one death per 1000 births, while this proportion is 10 times higher in low-income countries (9). A community-based study conducted in six low- to middle-income countries showed the incidence of stillbirth as 9 to 34 per 1000 births (4). These differences in the rates of stillbirth can be attributed to various prevalence of related risk factors such as high and low maternal age, multiple pregnancies, maternal smoking, maternal overweight, and obesity. Moreover, better access to gynecological services such as effective maternity care and interventional strategies during labor may reduce the rate of stillbirth (10).

The incidence of stillbirth has been reported as 10 per 1000 births in Iran (11). Over the last few decades, Iran has transformed into a middle-income country, which significantly affected the rate of stillbirth through changing maternal health condition, maternal quality of life, and healthcare provision. Nowadays, the majority of pregnancies are planned, and preterm cares are regularly provided to mothers by the primary healthcare system. It is also important to note that mothers who have pregnancy planning are provided with pre-pregnancy care in Iran. These healthcare programs are valid for one year and continue through eight caregiving sessions prior to delivery. All mothers are provided with iron supplementation and those with high-risk pregnancy are screened and identified. Approximately 95% of mothers give birth in hospitals with a cesarean rate of 45% (10).

2. Objectives

Given the importance of perinatal mortality, and regional and time differences in the occurrence of perinatal death, the present study was aimed to determine causes of stillbirth in 10 cities of Hormozgan province, southern Iran.

3. Methods

3.1. Study Design

This case-control study was conducted in 12 cities of Hormozgan province in 2015. The samples were randomly selected among mothers referring to health centers of Hormozgan province by cluster sampling. The inclusion criteria in the experimental group was Iranian mothers with a history of at least one stillbirth in the past five years, and for the control group Iranian mothers that have a live birth with no history of abortion and stillbirth.

A total of 40 clusters were randomly selected from the health centers of Hormozgan province. As such, 10 questionnaires for the experimental group and 10 for the control group were completed in each cluster. If all 10 questionnaires were not completed from the experimental group in the center of the cluster, the closest health center to the center of the cluster was selected to complete the number of samples, and questionnaires were then answered in the corresponding health center. One control per case was selected and pair matching was done for the area of living.

Considering the factor of the maternal age older than 35 years, the sample size was calculated as 400 in each group. With regard to possible dropouts in this study, the estimated sample size was increased to 425. A questionnaire designed by the research team was used to collect data. Content validity of the questionnaire was confirmed by four experts in statistics and epidemiology. In the reliability assessment, 50 questionnaires were completed by the control group, and the Cronbach's alpha calculated 0.64. This researcher-made questionnaire was comprised of data on maternal demographic characteristics (e.g. age, education, occupation, ethnicity, etc.), gestational age, infant's gender, type of delivery, birth weight, history of stillbirth, history of abortion, gap between pregnancies, pregnancy diabetes, preeclampsia, underlying diseases, premature rupture of membranes (PROM), maternal sleeping and nutritional status, and a history of physical violence. Content validity of the questionnaire was determined by specialists. Also, the reliability of the questionnaires was evaluated for nutritional status and history of violence. In order to confirm the validity of the questionnaire, a total of 50 questionnaires were completed by the control group, and the Cronbach's alpha was computed as 0.64. The questionnaires were completed through face to face interviews with mothers and based on the medical records of the mothers. Data collection was conducted by a group of trained personnel working in rural and urban health centers of Hormozgan province.

A total of 15 variables and 39 categories were selected and assigned in this study: maternal age (35 years and

younger, older than 35 years), father's age (35 years and younger, older than 35 years), maternal ethnicity (Fars, Arab, other), maternal education (illiterate, diploma, university education), father's education (illiterate, diploma, university education), maternal occupation (housewife, employee, other), father's occupation (self-employed, employee, other), area of living (rural or urban), birth order (first, second, third, fourth, more), gap between the current and previous pregnancy (first pregnancy, less than one year, one to three years, more than three years), history of stillbirth in previous pregnancies (yes, no), history of abortion in previous pregnancies: yes, no), hand and face swelling in current pregnancy (yes, no), high blood pressure in current pregnancy (yes, no), and type 2 diabetes in the current pregnancy (yes, no).

3.2. Statistical Analysis

Data analysis was performed using SPSS, version 21. Quantitative data were expressed as mean and standard deviation, and qualitative categorical and ordinal data were expressed as absolute and relative frequency. The univariate and multivariate logistic regression model were used to measure the correlation between variables within a significance level of 5%.

4. Results

A total of 825 mothers were recruited, of whom 403 mothers with a history of stillbirth were assigned into the experimental group, and 422 mothers with live birth were assigned into the control group. The average age of the participants was 27.68 ± 6.4 years in the experimental group and 26.96 ± 5.4 years in the control group. The average total fertility rate was 2.56 in mothers with a history of stillbirth, and 2.20 in controls.

Demographic characteristics of the study participants are presented in Table 1. According to the results, the majority of mothers in the experimental group (87.5%) and control group (94.7%) were aged 35 or younger. More than 70% of the mothers in both experimental and control groups had husbands aged 35 years or younger. Most of the mothers (> 90%) in both groups were housewives and the husband was mostly (> 60%) self-employed. Furthermore, most mothers in the case group (37%) were illiterate, whereas the majority of controls (43%) had a university education (Table 1).

The descriptive information on variables associated with pregnancy are presented in Table 2. Results show that, 36.2% of the participants in the experimental group and 33.4% of the controls reported that this was the first delivery. Also, 6.6% of the participants had stillbirth, and 0.7% of

Table 1. Demographic Characteristics of Study Participants

Variable	Experimental Group, No. (%)	Control Group, No. (%)
Maternal age		
35 years and younger	342 (87.5)	397 (94.7)
Older than 35 years	49 (12.5)	22 (5.3)
Average age	27.68	26.96
Father's age		
35 years and younger	281 (72.4)	318 (76.3)
Older than 35 years	107 (27.6)	99 (23.7)
Average age	32.03	31.68
Maternal ethnicity		
Fars	341 (86.5)	346 (84.2)
Arab	14 (3.6)	13 (3.2)
Other	39 (9.9)	52 (12.7)
Maternal education		
Illiterate	189 (37)	142 (27.8)
Diploma	180 (29.2)	231 (37.4)
University education	34 (29.8)	49 (43)
Father's education		
Illiterate	135 (33.7)	112 (27.9)
Diploma	233 (32)	262 (35.9)
University education	34 (31.2)	47 (43.1)
Maternal occupation		
Housewife	379 (94.8)	382 (91)
Employee	16 (4)	35 (8.3)
Other	5 (1.3)	3 (0.7)
Father's occupation		
Self-employed	274 (68.3)	266 (63.5)
Employee	43 (10.7)	75 (17.9)
Other	84 (20.9)	78 (18.6)
Area of living		
Urban	102 (25.8)	78 (18.8)
Rural	294 (74.2)	338 (81.3)

the controls had a history of stillbirth in the previous pregnancies. In addition, the odds of previous abortion among mothers with stillbirth and those with live birth were estimated as 9.7% and 1.5%, respectively (Table 2).

The results of the univariate analysis is revealed that the odds of stillbirth among mothers older than 35 years

Table 2. Descriptive Information on Variables Associated with Pregnancy in Study Participants

Variable	Experimental Group, No. (%)	Control Group, No. (%)
Birth order		
First	146 (36.2)	141 (33.4)
Second	105 (26.1)	134 (31.8)
Third	57 (14.1)	94 (22.3)
Fourth and more	95 (23.6)	53 (12.6)
Gap between current and previous pregnancy		
First pregnancy	141 (35.8)	133 (32)
Less than a year	29 (7.4)	6 (1.4)
One to three years	104 (26.4)	114 (27.4)
> 3 years	120 (30.5)	163 (39.2)
History of stillbirth in previous pregnancy	26 (6.6)	3 (0.7)
History of abortion in previous pregnancy	38 (9.7)	6 (1.5)
Face and hand swelling in current pregnancy	23 (5.7)	12 (2.8)
High blood pressure in current pregnancy	22 (5.5)	14 (3.3)
Type 2 diabetes in current pregnancy	19 (4.9)	14 (3.4)

was 2.58 times higher than mothers aged 35 years or younger [OR: 2.58, 95% CI (1.532 - 4.364)]. Besides, the odds of stillbirth in mothers with a university education was 0.52 times higher compared with illiterate mothers [OR: 0.52, 95% CI: (0.320 - 0.850)]. The odds of stillbirth among mothers whose husbands had university education was 0.60 times higher than in mothers with illiterate husbands [OR: 0.60, 95% CI (0.361 - 0.997)]. Moreover, the odds of stillbirth among employed mothers was 0.46 times higher than housewives [OR: 0.46, 95% CI (0.25 - 0.84)]. The odds of stillbirth among mothers with employed husbands was 0.55 times higher than those whose husbands were self-employed [OR: 0.55, 95% CI (0.369 - 0.840)]. The odds of stillbirth among mothers living in rural areas was 0.66 times higher than mothers living in urban areas [OR: 0.66, 95% CI (0.476 - 0.929)]. Also, the odds of stillbirth in women with history of stillbirth in previous pregnancies was 9.66 times higher than mothers with no history of stillbirth. The odds of stillbirth among mothers with history of abortion was 7.24 times higher than those with no history of abortion [OR: 7.24, 95% CI (3.027 - 17.342)]. The odds of stillbirth among mothers with swollen hand and face was two times higher than those with no signs of hand or face swelling [OR: 2.06, 95% CI (1.015 - 4.214)]. There was no significant correlation between blood pressure and diabetes in the current pregnancy among mothers with stillbirth ($P > 0.05$) (Table 3).

The results of the multivariable regression analysis revealed that the odds of stillbirth among mothers older than 35 years was 2.33 times higher than mothers aged 35 years or younger [OR: 2.33, 95% CI (1.287 - 4.246)]. In addition, the odds of stillbirth among mothers with a university education was 0.32 higher than illiterate mothers [OR:

0.32, 95% CI (0.179 - 0.589)]. The odds of stillbirth among mothers living in rural areas was 0.51 higher than those living in urban areas [OR: 0.51, 95% CI (0.348 - 0.754)]. In women who had a previous history of stillbirth, the risk of stillbirth was 10 times higher than mothers who reported no history of stillbirth [OR: 10.1, 95% CI (2.846 - 35.973)]. The odds of stillbirth among mothers with a history of abortion was 8.72 times higher than those with no previous abortion [OR: 8.72, 95% CI (3.407 - 22.323)] (Table 4).

Due to an average data missing of 4% in this research, the number of samples presented in the tables is less than the total studied samples.

5. Discussion

The results of this work on a large population of pregnant women show that mothers with certain demographic characteristics or pregnancy-related factors were more likely to have a stillbirth. Generally, the findings of this study suggest adverse effects of these factors on the fetus.

After matching for all demographic variables and factors associated with pregnancy and eliminating the effect of confounding factor in the present research, a significant positive correlation was observed between maternal age and occurrence of stillbirth. The odds of stillbirth among mothers aged older than 35 years was 2.33 times higher, which was in compliance with previous studies. A cohort retrospective study conducted in the USA studied two groups of women older and younger than 35 years and showed that within the 37th to 42nd weeks of gestation, the risk of stillbirth was shown to increase among mothers aged 35 or older (12). Another research conducted in

Table 3. Univariate Analysis of Factors Associated with Stillbirth Among Study Participants

Variable	OR (95% CI)	P Value
Maternal age		
35 years and younger	Reference	Reference
Older than 35	2.585 (1.532 - 4.364)	0.0004
Maternal education		
Illiterate	Reference	Reference
Diploma	0.585 (0.437 - 0.784)	0.0003
University degree	0.521 (0.320 - 0.850)	0.009
Father's education		
Illiterate	Reference	Reference
Diploma	0.738 (0.543 - 1.002)	0.052
University degree	0.6 (0.361 - 0.997)	0.049
Maternal occupation		
House wife	Reference	Reference
Employee	0.461 (0.251 - 0.847)	0.013
Other	1.680 (0.339 - 7.079)	0.480
Father's occupation		
Self-employed	Reference	Reference
Employee	0.557 (0.369 - 0.840)	0.005
Other	1.045 (0.736 - 1.486)	0.804
Area of living		
Urban	Reference	Reference
Rural	0.665 (0.476 - 0.929)	0.017
Gap between the current and previous pregnancy		
Less than 1 year	Reference	Reference
1 to 3 years	0.189 (0.075 - 0.473)	0.0004
More than 3 years	0.152 (0.061 - 0.378)	0.00005
First pregnancy	0.219 (0.088 - 0.545)	0.001
History of stillbirth in previous pregnancies		
No	Reference	Reference
Yes	9.661 (2.9 - 32.185)	< 0.001
History of abortion in previous pregnancies		
No	Reference	Reference
Yes	7.246 (3.027 - 17.342)	< 0.001
Hand and face swelling in current pregnancy		
No	Reference	Reference
Yes	2.068 (1.015 - 4.214)	0.045
High blood pressure in current pregnancy		
No	Reference	Reference
Yes	1.683 (0.849 - 3.337)	0.136
Diabetes in current pregnancy		
No	Reference	Reference
Yes	1.445 (0.714 - 2.925)	0.306

Sweden reported that the odds of stillbirth among mothers aged 35 years or older was 2.2 times higher compared with mothers aged younger than 35 years, which was consistent with our study (13). Hypertension and diabetes are two of the most common medical conditions complicating pregnancy; both of these conditions historically have been responsible for a significant proportion of stillbirths (14). The placental constraint may be other one reason for

the association between advanced maternal age and stillbirth risk is supported by some study. Considerable indirect evidence that uteroplacental blood flow decreased by maternal age advancing (15). The best time to get pregnant is between the age of 18 and 35 years (16). Due to the great effect of maternal age on health of mother and fetus and because this factor can be planned and controlled, great attention should be paid to prevention interventions such as

Table 4. The Multivariate Analysis of Factors Associated with Stillbirth Among Study Participants (Variables with a P Value Less Than 0.3 in the Univariate Regression Model Were Entered into the Multivariate Regression Analysis)

Variable	OR (95% CI)	P Value
Maternal age		
35 years or less	Reference	Reference
Older than 35	2.338 (1.287 - 4.246)	0.005
Maternal education		
Illiterate	Reference	Reference
Diploma	0.519 (0.368 - 0.731)	< 0.001
University education	0.325 (0.179 - 0.589)	< 0.001
Area of living		
Urban	Reference	Reference
Rural	0.513 (0.348 - 0.754)	0.001
History of stillbirth in previous pregnancies		
No	Reference	Reference
Yes	10.117 (2.846 - 35.973)	< 0.001
History of abortion in previous pregnancies		
No	Reference	Reference
Yes	8.721 (3.407 - 22.323)	< 0.001

those aimed at maintaining the gap between pregnancies.

According to the results, a significant relationship was observed between maternal education and stillbirth. As such, the odds of stillbirth among mothers with a university education was shown to be higher than illiterate mothers (OR = 0.32), which was in line with the results of a study conducted in Bangladesh (17). Another study conducted in the US showed that the odds of stillbirth among illiterate mothers or those with an elementary education was 1.51 times higher than mothers with a university education (18). The level of education is a socio-economic indicator which is directly correlated with stillbirth (19).

Also, there was a reverse significant correlation between the maternal area of living and stillbirth. Accordingly, the risk of stillbirth was lower among mothers living in rural areas than in those living in urban areas. In a study conducted in Astara, the quality of maternity healthcare services provided in urban health centers was poorer than rural health centers (20). It can be concluded that the higher number of applicants may adversely affect the services provided in urban areas. Identification of all pregnant women in rural areas by rural primary healthcare workers and provision of services explains the better quality of such services in rural areas. Since it is impossible to identify and provide health care services to all pregnant women in cities by public health centers, mothers should visit health centers, which may affect timely prevention of pregnancy side effects such as stillbirth.

In addition, there was a significant correlation between the history of stillbirth in previous pregnancies and occurrence of stillbirth, that is the odds of stillbirth among mothers with the history of stillbirth is 10 times higher

than other mothers. A significant correlation was also observed between the history of abortion in previous pregnancies and occurrence of stillbirth, as the risk of stillbirth among mothers with the history of abortion was 8.72 times higher. Missouri and colleagues (2007) stated that the odds of stillbirth in a second pregnancy among mothers with history of stillbirth in their first pregnancy was five times higher than in mothers with no history of stillbirth (21). The results of a study carried out in Rafsanjan city proposed that stillbirth is significantly correlated with intrauterine fetal death (22). In a case-control study conducted in Arak, the frequency of stillbirth among women who reported a history of abortion was significantly higher (16). According to a research conducted in Golestan, the risk of stillbirth among women with history of stillbirth and abortion was 10.67 and 1.14 times higher, respectively (10).

There are certain genetic and medical conditions that increase the risk of stillbirth such as thalassemia, diabetes, and antiphospholipid syndrome (23). Since the history of abortion and stillbirth are among the important factors associated with perinatal mortality and due to insufficient healthcare provision during pregnancy, inappropriate nutritional status of mothers and weak socioeconomic status have been shown to increase the risk of stillbirth (24). Identification of mothers with a history of stillbirth and abortion, providing these individuals with sufficient healthcare services during pregnancy, and effective intervention aimed at to improving their nutritional status can help to reduce perinatal mortality.

The required information was obtained from interviews with mothers and medical records. Considering the

retrospective approach of the information and odds that mothers may forget some information or any defects in documenting medical records by health personnel. We suggest further future research to remove these limitations to improve the validity and accuracy of the results.

5.1. Conclusions

The findings of this paper show a number of preventable factors associated with perinatal mortality. The results of this study may help to effectively conduct future research, and help supervisors and policymakers make evidence-based operational decisions. It is hoped that merging the rating system of perinatal services in mothers' health system will contribute to the identification of high-risk pregnancies, provide mothers with better and higher-quality healthcare services, and prevent pregnancy loss due to preventable causes.

Supplementary Material

Supplementary material(s) is available [here](#) [To read supplementary materials, please refer to the journal website and open PDF/HTML].

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Footnotes

Authors' Contribution: Study concept and design: Hamid Reza Tabatabaee and Halimeh Yaghoobi. Analysis and interpretation of data: Halimeh Yaghoobi, Maryam Soltani, and Fatemeh Zolfizadeh. Drafting of the manuscript: Halimeh Yaghoobi, Fatemeh Zolfizadeh, and Maryam Ghorbani. Critical revision of the manuscript for important intellectual content: Hamid Reza Tabatabaee, Naser Nasiri, Shirin Soltani, Soghra Kamali, and Maryam Soltani. Statistical analysis: Halimeh Yaghoobi and Maryam Soltani.

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