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Downward Trend in Maternal Mortality Ratio in Khorasan Razavi Province, Iran

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ABSTRACT

Background & aim: Maternal mortality is defined as the death during pregnancy or up to 42 days postpartum. This study sought to determine the trend of maternal mortality ratio (MMR) and its associated factors in Khorasan Razavi province, Iran.
Methods: This retrospective cross-sectional study was conducted in Khorasan Razavi Province, North East of Iran, during 2010 to 2014. Data was collected from the reports of Maternal Mortality Committee of Mashhad University of Medical Sciences, Mashhad, Iran. The MMR was calculated for each period, and its trend was estimated. Chi-square test was used to find the relationship between mode of delivery and direct or indirect causes of maternal death.
Results: According to the results, 94 maternal deaths occurred during 2010 to 2014. The total MMR was 17.68 (95%CI: 13.59-21.77) per 100,000 live births. The mean maternal age was 30.7±6.1 years old. Most of the deaths (75.6%) occurred during postpartum period, from which 81% happened following a high-risk pregnancy. In addition, 50% of the mothers had proper numbers of visits during pregnancy. The most direct and indirect causes of maternal death were maternal hemorrhage (24.5%) and cardiovascular diseases (12.8%), respectively. The relative risk of maternal mortality associated with cesarean section was 1.3 in comparison to normal vaginal delivery.
Conclusion: The estimation of MMR is essential for decision-making and resource allocation. To reach this goal, a good registration system is needed to register all deaths and their exact causes.

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Introduction

Maternal mortality is one of the most important indicators of development and the burden of disease (1-3). The MMR is defined as the number of maternal deaths per 100,000 live births in a given time period, which is 16 and 230 in developed and developing countries, respectively (4). Millennium Development Goals aimed to reduce maternal mortality ratio (MMR) by three quarters between 1990 and 2015 (5). Recently, the MMR has decreased; however, a considerable number of maternal deaths still occurs in the developing countries. The risk of hemorrhage-related maternal mortality in developing countries is much higher than developed countries (6).

The World Health Organization (WHO) reported that the MMR was 23 in Iran, 2013. Several causes of maternal deaths are preventable; therefore, it is essential to identify these causes in order to reduce the MMR.

There was no similar study in the North East of Iran; accordingly, this study sought to determine the trend of MMR and its associated factors in Razavi Khorasan Province, North East

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of Iran, during 2010 to 2014.

Materials and Methods

This retrospective cross-sectional study was conducted in Khorasan Razavi Province, Iran, during five years from 21 March 2010 to 20 March 2014. Data was collected from the reports of Maternal Mortality Committee of Mashhad University of Medical Sciences, Mashhad, Iran. The Committee was consisted of trained professionals in this field including a gynecologist, an anesthesiologist, a hospital director, a representative of the Deputy Minister of Health, a midwife, a nurse, and a forensics expert.

To determine the MMR, the number of maternal deaths per year was divided to the number of live births in the same period. The number of live births per year was obtained from the Statistics Center of Mashhad University of Medical Sciences, Mashhad, Iran. The cause of death was determined based on the existing evidence, documented prenatal care, hospitalization records, verbal reports, and autopsy results.

Thereafter, for each case only one cause was considered according to the 10th International Classification of Diseases, and accidental deaths were not examined. The viewpoint of forensics was considered as the standard cause of death in the cases with several probable causes. If there was no forensics expert, the cause of death was considered indeterminate. Then, the causes of deaths were divided into two groups of direct maternal death (as a result of obstetric complications, interventions, omissions, mistreatment, or a chain of the events mentioned above) and indirect obstetric deaths (as a result of underlying disorders or disease that developed during pregnancy and that was not due to direct obstetric causes, but was aggravated by the physiologic effects of pregnancy) (7). The most common causes of direct maternal death entailed hemorrhagic shock, septic shock, preeclampsia, eclampsia, amniotic fluid embolism, acute fatty liver of pregnancy, thrombotic thrombocytopenic purpura, and hemolysis, elevated liver enzymes, and low platelet count (HELLP syndrome). Additionally, malignancy, internal hemorrhage, and drug overdose, as well as cardiovascular, central nervous system (CNS), pulmonary, and renal diseases were among the causes of indirect obstetric deaths. Moreover, deaths with unknown etiology were considered as an independent group.

The demographic information (e.g., maternal age, past medical history, residence location (urban or rural), and date of death) and obstetric data including gravidity, intended or unintended pregnancy, time of death (during pregnancy, delivery, or postpartum period), birth location (hospital or health facility, home, and during transportation), high- or low-risk pregnancy, delivery method (normal vaginal delivery, cesarean section, or abortion), interval between the two last pregnancies, presence or absence of pre-pregnancy care, and prenatal care (the number of visits during pregnancy, time of first care, and health care personnel) were obtained from The Maternal Mortality Committee.

The high-risk group included the females with the history of rheumatoid arthritis, asthma, coagulopathy, acquired immunodeficiency syndrome, ischemic heart disease, valvular heart disease, gastrointestinal diseases, chronic kidney disease, hyper- or hypothyroidism, prolactinoma, kidney transplantation, thalassemia minor, thromboembolism, diabetes, tuberculosis, breast cancer or a history of breast cancer, epilepsy, lupus, multiple sclerosis, migraine, a history of infertility, skeletal limb abnormalities, abnormal genitalia, hepatitis, mental disorders, and domestic abuse, as well as toxoplasmosis, rubella, and being infected by cytomegalovirus, herpes simplex, or other agents (8).

Sample size determination was not required because all the cases were studied in this five-year period. Data was encoded and entered to the computer anonymously, and data analysis was performed using descriptive statistics in SPSS software, version 11.5. The MMR was calculated for each period, and the trend of MMR was plotted. In addition, the frequency of death (per 100,000 procedures) was computed according to the delivery method. Chi-squared test was applied to find a relationship between delivery method and direct or indirect causes of death. In all the measurements, P-value less than 0.05 was considered statistically significant.

This study was approved by the Ethics Committee of Mashhad University of Medical

Sciences, Mashhad, Iran.

Results

There were 94 maternal deaths during 2010 to 2014. The trend of MMR is demonstrated in Figure 1.

According to the results, total MMR was 17.68 (95%CI: 13.59-21.77). The mean maternal age was 30.7±6.1 years old ranging from 17 to 46 years old.

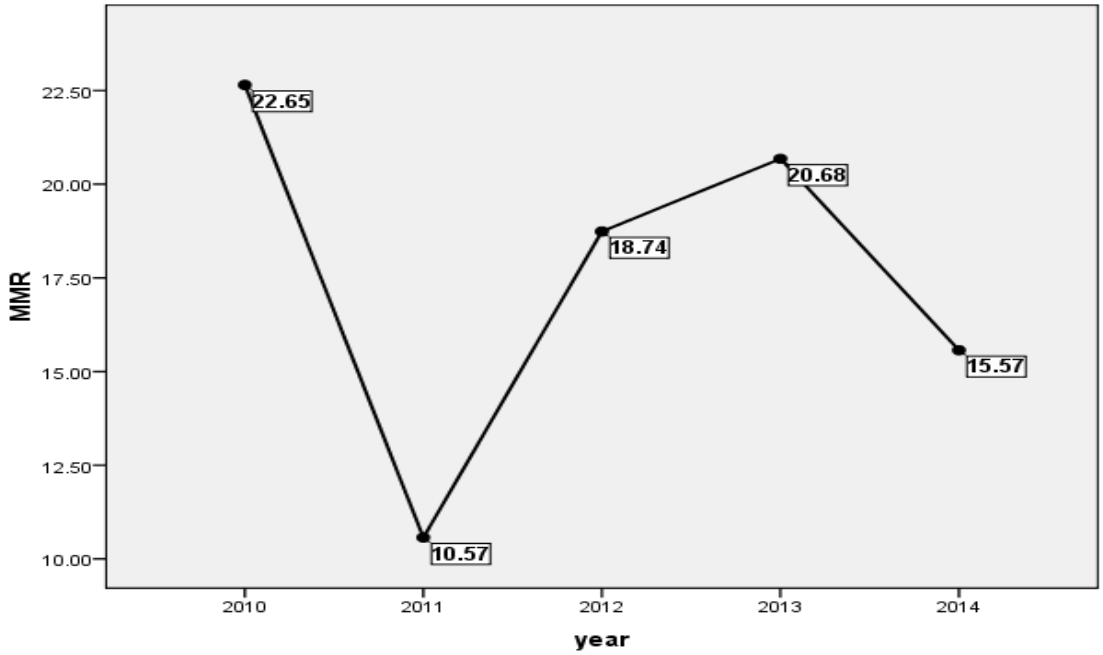

Figure 1. Maternal mortality rate trend from March 2010 to March 2014 in Razavi Khorasan Province, Iran

Given the results, 75.6%, 22.3%, and 2.1% of deaths occurred during postpartum, pregnancy, and delivery periods, respectively.

Most of the cases (85.1%) died in hospital or healthcare facilities, and 81% of the cases had high-risk pregnancies. Furthermore, 67.2% of the subjects had not pre-pregnancy care, while 50% of them had proper numbers of visits during pregnancy. The time of first care was appropriate in 47.5% of the cases. As shown in Table 1, most of the cases (72.1%) were visited by trained healthcare providers.

According to Table 2, 54.3% and 36.1% of the cases died as a result of direct and indirect obstetric deaths, respectively. The most common direct cause of death was maternal hemorrhage (24.5%), while the most indirect cause was cardiovascular disease (12.8%).

As demonstrated in Table 3, the relative risk of maternal death associated with cesarean section was 1.3 in comparison to normal vaginal delivery. Given the results, 29 mothers had normal vaginal delivery, 82.8% of whom (24 cases) died as a result of direct maternal causes of death, and the cause of death was indeterminate in two cases. In 45.2% of the women who had normal vaginal delivery (14 mothers), maternal hemorrhage was reported as the leading cause of death.

In 50% (21 cases) of mothers with cesarean section, a direct cause of maternal death was the main cause of death, and the cause of death was indeterminate in two cases. As the results of the present study indicated, there was a significant association between the delivery method and direct or indirect causes of death (P=0.008).

Table 1. Demographic and clinical parameters of the cases

Criterion	High risk	Low risk	Number (%)
Number (%)	76 (80.9)	18 (19.1)	
Age groups			
18 years old and younger	1 (1.3)	1 (5.6)	2 (2.1)
19-34 years' old	53 (69.7)	14 (77.8)	67 (71.3)
35 years and older	22 (28.9)	3 (16.7)	25 (26.6)
Residence location			
Urban	55 (72.4)	14 (77.8)	69 (73.4)
Rural	21 (27.6)	4 (22.2)	25 (26.6)
Kind of pregnancy			
Intended	68 (89.5)	14 (77.8)	82 (87.3)
Unintended	7 (9.2)	3 (16.7)	10 (10.6)
Indeterminate	1 (1.3)	1 (5.6)	2 (2.1)
Gravidity			
Three or less	52 (68.4)	14 (77.8)	66 (70.2)
More than three	24 (31.6)	4 (22.2)	28 (29.8)
Inter-pregnancy interval			
24 months or less	5 (11.6)	4 (36.4)	9 (16.7)
Over 24 months	38 (88.4)	7 (63.6)	45 (83.3)
Death occurred during			
Pregnancy	15 (19.7)	6 (33.3)	21 (22.3)
Delivery	2 (2.6)	0	2 (2.1)
Postpartum	59 (77.6)	12 (66.7)	71 (75.6)
Place of death			
Hospital or healthcare centers	65 (85.5)	15 (83.3)	80 (85.1)
Home	5 (6.6)	1 (5.6)	6 (6.4)
During transportation	5 (6.6)	1 (5.6)	6 (6.4)
Others*	1 (1.3)	1 (5.6)	2 (2.1)
Pre-pregnancy care			
Yes	17 (39.5)	3 (16.7)	20 (32.8)
No	26 (65.5)	15 (83.3)	41 (67.2)
The number of visits			
Appropriate	38 (50)	9 (50)	47 (50)
Inappropriate	25 (32.9)	6 (33.3)	31 (33)
Indeterminate	13 (17.1)	3 (16.7)	16 (17)
Time of first care			
appropriate	22 (51.2)	7 (38.9)	29 (47.5)
Inappropriate	13 (30.2)	8 (44.4)	21 (34.4)
indeterminate	8 (18.6)	3 (16.7)	11 (18)
Healthcare staff			
Appropriate	31 (72.1)	13 (72.2)	44 (72.1)
Inappropriate	8 (18.6)	5 (27.8)	13 (21.3)
Indeterminate	4 (9.3)	0	4 (6.6)

*One death occurred in a doctor's office and another during traveling abroad

Table 2. The causes of maternal mortality

Cause of death	Number (%)
Directly related to the pregnancy	
Maternal hemorrhage	23 (24.5)
Pregnancy-related infections	5 (5.3)
Hypertensive disorders Sever preeclampsia, HELLP* syndrome, and eclampsia	11 (11.7)
Amniotic fluid embolism	6 (6.4)
Fatty liver of pregnancy	6 (6.4)
Indirectly related to the pregnancy	
Cardiovascular disease	12 (12.8)
Central nervous system disorders	9 (9.6)
Malignancy	4 (4.2)
Pulmonary disorders	4 (4.2)
Renal disorders	1 (1.1)
Internal hemorrhage	2 (2.1)
Drug overdose	2 (2.1)
Indeterminate	9 (9.6)
Total	94 (100)

*Hemolysis, elevated liver enzymes, low platelet count

Table 3. Maternal mortality rate with respect to the deliver method

Delivery method	Number of procedures	Number of deaths	Maternal mortality rate
Normal vaginal delivery	253459	31	12.23
Cesarean section	280957	44	15.66

Discussion

Regarding the results of the current study, in Iran, the total MMR was 17.68 (95%CI: 13.59-21.77) during five years, which was similar to developed countries (16 deaths per 100,000 live births in 2013) (9). However, it is worth mentioning that the direct comparison of MMR index is unreliable because the definition of MMR is different among developed and developing countries (10). The WHO reported that the MMR in Iran has been decreased by 72% and annual average rate of 5.3% (5).

In Iran, the MMR index was 83, 60, 44, 31, and 23 in 1990, 1995, 2000, 2005, and 2013, respectively (9). In similar studies conducted in other regions of Iran, the MMR was 25.9 in Kermanshah Province from 2001 to 2012, 22.18 in Fars Province from 2003 to 2010, and 42.4 in West Azerbaijan Province from 2001 to 2005. Accordingly, in Iran, the MMR was much lower than other developing countries.

According to the literature, the mean MMR in India was 222 from 2003 to 2012 (11). In this study, the mean maternal age was 30.7±6.1 years old. It was demonstrated that the risk of obstetric complications increased along with the maternal age (12-14). This result might be due to the incidence of cardiovascular diseases and thromboembolism complications in older ages. Therefore, different obstetric cares were needed in advanced maternal ages (12).

Given the evidence, increasing parity was associated with increased risk of maternal mortality (15, 16). Nevertheless, in the present study, the gravidity of the majority of the cases (70.2%) was three pregnancies or less, which might be due to the decreased total fertility rate in recent years in Iran.

According to the results, the most common causes of death (54.3%) were directly related to the pregnancy; nonetheless, another study carried out in India determined the indirect causes of death as the most common causes of maternal death (51.4%) (11). In our study, the cause of death was indeterminate in 9.6% of the cases; however, in India, 1.9% of the cases had indeterminate cause (11). This inconsistency might be because several families did not allow to do autopsy.

As the results of the present study indicated, the most common direct cause of maternal death was maternal hemorrhage (24.5%); this result was in line with the results of other similar studies (6, 11). Postpartum hemorrhage is the leading cause of preventable death; therefore, early diagnosis and timely treatment is of paramount importance (6). The risk of hemorrhage-related maternal mortality is 100 times higher in developing countries than the developed ones (6).

It is estimated that hemorrhage is the cause of one-third of maternal mortality in Asia and Africa (6). El-Refaey revealed that hemorrhage-related mortality is associated with multiparity, limited access to care, anemia, and uterine fibroids (17). Two recent reports demonstrated that 73%-93% of maternal deaths due to postpartum hemorrhage were preventable (18, 19). Moreover, 73% and 93% of hemorrhage-related deaths were preventable in the United States and worldwide, respectively (6). Recognition of risk factors of hemorrhage is necessary for optimal treatment (6).

The complications of preeclampsia and amniotic fluid embolism were the causes of death in 9.6% and 6.4% of the cases, respectively. According to the results of a study performed in United States, preeclampsia and amniotic fluid embolism are the leading causes of maternal death in 15% and 14% of cases (10). This study presented less percentage of preeclampsia, which was probably due to the fact that four cases with hemorrhagic stroke due to hypertension were assigned to the group of CNS diseases. Regarding the results of this study, acute fatty liver of pregnancy as a severe maternal morbidity was the leading cause of 6.4% of maternal deaths (20). Furthermore, cardiovascular diseases (12.8%) were the most indirect cause of maternal death (11).

According to the results of a multicenter prospective study, caesarean section increases the risk of maternal mortality and morbidity in cephalic presentation (21). In this study, the relative risk of maternal death associated with cesarean section was 1.3 compared to normal vaginal delivery. Given the results of the study conducted by Clark, this may be because most of the cesarean section-associated maternal mortalities were due to the medical condition that make the cases to have a cesarean section (4).

Several methods were implemented to decrease the maternal mortality rate such as providing standard protocols of care, quality improvement rather than a punitive methods, and comprehensive patient safety programs in healthcare settings (10).

The strengths of this study were the report of the MMR in a long period and using a reliable community-based data.

On the other hand, there are many possible limitations that might affect our results. The most important limitation of the present study was its retrospective design and view data that was previously recorded. Another limitation was that the data was collected on delay and after several joint meetings between the members of the Maternal Mortality Committee; therefore, we did not have access to recent data. Given the type of our study, we could not identify all causes of maternal mortality.

Conclusion

Regarding the results obtained in the present study, it is essential to estimate the MMR for proper decision-making and resource allocation. To reach this goal, a good registration system is needed that registers all deaths, as well as their exact cause.

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Conflicts of interest

The authors declare no conflicts of interest.

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