Maternal Mortality and its Causes in Kermanshah Province, Iran: Trends between 2011 and 2021

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ABSTRACT

Introduction: Maternal mortality is one of the critical public health challenges worldwide, especially in less developed countries. Understanding the burden, trend, and causes of maternal deaths is a key requirement to further policymaking, resource allocation, and devise targeted intervention policy. Therefore, this study was aimed to estimate the maternal mortality rate (MMR) and highlight the associated causes in Kermanshah province, western Iran during 2011–2021.

Material and Methods: This cross-sectional study was conducted in Kermanshah Province, in the west of Iran, from March 2011 to December 2021. The study population included pregnant women who died from causes related to pregnancy or childbirth and had healthcare records in the rural or urban health centers of the province. The maternal deaths were reviewed and confirmed by the Provincial Maternal Death Expert Committee.

Results: During the 10-year study period, 69 maternal deaths occurred. Maximum maternal deaths (30.4%) were reported in the age group of 36 to 40 years. Nearly 75% of the mothers were at high risk during the perinatal period. Approximately 42% had a history of a major chronic illness. Plus, 55.1% of maternal deaths were due to direct causes comprising hemorrhage (21.7%), pregnancy-related infection (20.3%), and hypertensive disorders in pregnancy (11.6%) whereas, 44.9% were due to indirect causes including pulmonary embolism (13%), suicide (11.6%), and cardiovascular disease (10.1%). The MMR during the period of the study elevated from 18 deaths per 100 000 live births in 2011 to 36 in 2021.

Conclusion: Most contributory factors of maternal deaths in our state are preventable through combined safe motherhood strategies comprising focused antenatal care, prompt referral system, and active management of labor. This study has suggested that mothers in the postpartum period need to be monitored more carefully, and especially for hemorrhage.

Introduction

Maternal death during pregnancy, childbirth, or postpartum is a serious concern with catastrophic effects on families and health systems. The World Health Organization (WHO) has described maternal death as the death of a woman while pregnant or within 42 days of termination of pregnancy, regardless of

whether the cause was related to or aggravated by pregnancy. The maternal mortality ratio (MMR), is the most common indicator for international comparisons of maternal health, defined by the number of maternal deaths per 100,000 live births (1). Maternal death has been known as a primary indicator of the quality of health care internationally (2).

Maternal death is categorized into 2 groups of related deaths: direct obstetric causes, for example hemorrhage, eclampsia, and etc., and also, indirect causes, such as HIV, anemia, and etc. which may be result from previously existing diseases, or diseases that developed during pregnancy, or diseases that are aggravated by the physiological effects of pregnancy (3).

Reducing maternal mortality is one of the eight Millennium Development Goals (MDGs) and recently chosen as one of the main targets of Sustainable Development Goals (SDGs). Under target, all countries committed to end preventable maternal mortality and decreasing the global maternal mortality ratio to less than 70 per 100 000 live births by 2030 (4, 5). MMR globally declined from 342 deaths per 100 000 live births in 2000 to 223 deaths per 100 000 live births in 2020 (-34·8%) (6). Across the world, low- and middle-income countries were responsible for 94% of all maternal mortality, most of which could have been prevented (7). Thus, much attention should be paid to low- and middle-income countries for reducing a significant burden to the global MMR (8).

The Islamic Republic of Iran is a middle-income country with a population of about 84 million (nearly 49% female). The Iranian government has implemented multiple national programs to decrease the maternal deaths over the past four decades, such as (i) establishing the primary healthcare system in Iran staffed with trained community health workers (Behvarz) mainly in rural areas since the 1980s (9), (ii) implementing the family physician program and the health sector evolution plan (10), and (iii) constantly improving maternal healthcare services (11). So, significant progress had been made in improving maternal health in Iran, the national MMR declined from 48 per 100,000 live births in 2000 to 17.7 per 100,000 live births in 2018 (12).

A valid estimate of MMR and determining the causes of maternal mortality are critical for effective policymaking, resource allocation, health program decision-making, tailoring innervations, and supporting from pregnant women. Therefore, this study was aimed to estimate the MMR and highlight the causes of maternal mortality in Kermanshah province, western Iran.

Methods

Setting and Study design
This cross-sectional study was conducted in Kermanshah Province, in the west of Iran, from March 2011 to December 2021. The study population included pregnant women who died from causes related to pregnancy or childbirth and had healthcare records in the rural or urban health centers of the province. Kermanshah province, as a Kurdish region, includes 14 cities and a population of 1,997,864 people. In this province, there are 87 health centers (61 in rural and 26 in urban areas) and 631 health houses. During the 10-year study period, 69 maternal deaths occurred. The deaths occurred in different parts of the province in both urban and rural areas. The maternal deaths were reviewed and confirmed by the Provincial Maternal Death Expert Committee based on the 10th revision of the International Classification of Diseases codes (ICD 10).

Instrument used for data collection
Data were extracted from primary healthcare records available at the province health center. Moreover, data was collected using a researcher-developed questionnaire by a general physician. The questionnaire included data on mothers' age, gestational age, mothers' education, body mass index (BMI), residence, gravidity, parity, the type of childbirth, causes of death, past medical history and comorbidity, type of pregnancy (wanted or unwanted), receipt of antenatal

care, time of death, and etc.

Data Analysis

Data analysis was performed using the statistical package for social sciences (SPSS), version 26. Normally distributed variables (e.g., age and gestational age) were described using mean ± standard deviation (μ±SD). Otherwise, qualitative variables were reported as frequencies and percentages.

In addition, MMR was calculated by the number of maternal deaths per 100,000 live births. Mean maternal mortality ratio for the study period was calculated by calculating the mean of yearly MMR of the entire study period.

$$MMR = \frac{\text{Total number of maternal deaths}}{\text{Total number of live births}} * 100,000$$

Ethics

The Research Ethics Committee at Deputy of Research of the Kermanshah University of Medical Sciences (KUMS) had approved the study protocol and had monitored the research process (ethics code :IR.KUMS. REC.1400.318). Further, individual personal information was kept confidential.

Results

Table 1 shows Sociodemographic and medical information of pregnant women who died from 2011 to 2021. Their mean age and gestational stage of their pregnancies were 32.98 ± 6.76 (μ±SD) years and 30.28 ± 8.71 weeks, respectively. Maximum maternal deaths (30.4%) were reported in the age group of 36 to 40 years. 53.6% had completed primary/guidance school. Most (98.6%, 68/69) were unemployed or housewives. More maternal deaths were reported in women from urban areas (59.4%) as compared to women from rural areas (40.6%). 30.4% of the cases were primigravida. Gravid ≥4 in 22 other cases (31.9% of the total) was reported. More deaths were reported in multiparous women (50.7%) as compared to primiparas (34.8%). 63 (91.3%) women had been receiving regular antenatal care during their pregnancy. About 84.1% had received primary care from both a PHCC and a gynecologist. The history of stillbirth was 15.9%. In our survey, 75.4% of the mothers who died were at high risk during the perinatal period. About 42% had a history of a major chronic illness, such as cardiovascular disease (7.2%), addiction (5.8%), hypertension (4.3%), asthma (4.3%), hypothyroid (4.3%), and etc.

Most deaths occurred during the postpartum period (69.6%), and 29.0% occurred in the antepartum period. Nearly 89.9% of the mothers died in hospitals or health facilities, 1.4% died during transportation to the health facility and 8.7% died at home. About 52.2% of the deaths occurred after cesarean delivery, 20.3% after normal vaginal delivery, and 4.3% after an abortion (Table 1).

Table 1. Sociodemographic and medical information of pregnant women, west Iran 2011-2022 (N=69).

Characteristic	Subgroup	N (%)
Age, year	17-25	10(14.5)
	26-30	17(24.6)
	31-35	11(15.9)
	36-40	21(30.4)
	41-46	10(14.5)
Gestational age, week	8-21	12(17.4)
	22-30	17(24.6)
	31-35	18(26.1)
	36-41	22(31.9)
Region of residence	Urban	41(59.4)
	Rural	28(40.6)
Educational status	Illiterate	7(10.1)
	Primary/guidance school	37(53.6)
	High school	15(21.7)
	College& university	10(14.5)
Work status	Housewife/ unemployed	68(98.6)
	Physician	1(1.4)

Table 1 Continue

Gravid	1	21(30.4)
	2	13(18.8)
	3	13(18.8)
	4≤	22(31.9)
Parity	0	10(14.5)
	1	24(34.8)
	2	14(20.3)
	3	12(17.4)
	4≤	9(13.0)
Prior stillbirth	Yes	11(15.9)
Comorbidity	Yes	29(42.0)
High-risk pregnancy	Yes	52(75.4)
Type of pregnancy	Wanted	51(73.9)
	Unwanted	18(26.1)
Receipt of antenatal care	Unbooked	6(8.7)
	PHCC(only)	5(7.2)
	PHCC and gynecologist	58(84.1)
Delivery type	Normal vaginal delivery	14(20.3)
	Cesarean	36(52.2)
	Abortion	3(4.3)
	Pre-delivery maternal death	16(23.2)
Time of death	During pregnancy	20(29.0)
	During delivery	1(1.4)
	Post-delivery	48(69.6)
Location of death	Home	6(8.7)
	Hospital	62(89.9)
	On way to hospital	1(1.4)

In the study period, 55.1% of maternal deaths were due to direct causes. The classical triad of obstetric hemorrhage (21.7%), pregnancy-related infection (20.3%), and hypertensive disorders in pregnancy (11.6%) was the major direct causes of maternal deaths, whereas only one maternal death (1.4%) was due to acute fatty liver of pregnancy. In the study period, 44.9% of maternal deaths were due to indirect causes. Pulmonary embolism, suicide, and cardiovascular disease accounted for 13%, 11.6%, and 10.1% of maternal deaths respectively, and miscellaneous cause like malignancy, respiratory disease, DIC, and vascular anomaly accounted for 10.2% of maternal deaths as shown in Table 2.

Year-wise distribution of MMR is shown in Figure 1. It appears that from a low of around 18 in 2011, the MMR rose rapidly throughout 2017 to a peak of 30 maternal deaths per 100 000 live-births. The MMR then fell to around 10 by 2018 and rose to an estimated 40 and 36 in 2020 and 2021, respectively. In the previous ten years (2011–2021), the total MMR was 20 per 100000 live births.

Table 2. direct and indirect causes of death (n=69).

| Characteristic	N (%)
Indirect causes	31(44.9)
Pulmonary embolism	9(13.0)
Cardiovascular disease	7(10.1)
Malignancy	2(2.9)
Respiratory disease	2(2.9)
Disseminated intravascular coagulation	1(1.4)
Suicide	8(11.6)
Vascular anomaly	2(2.9)
Direct causes	38(55.1)
Hypertensive disorders in pregnancy	8(11.6)
Obstetric hemorrhage	15(21.7)
Pregnancy-related infection	14(20.3)
Acute Fatty Liver of Pregnancy	1(1.4)
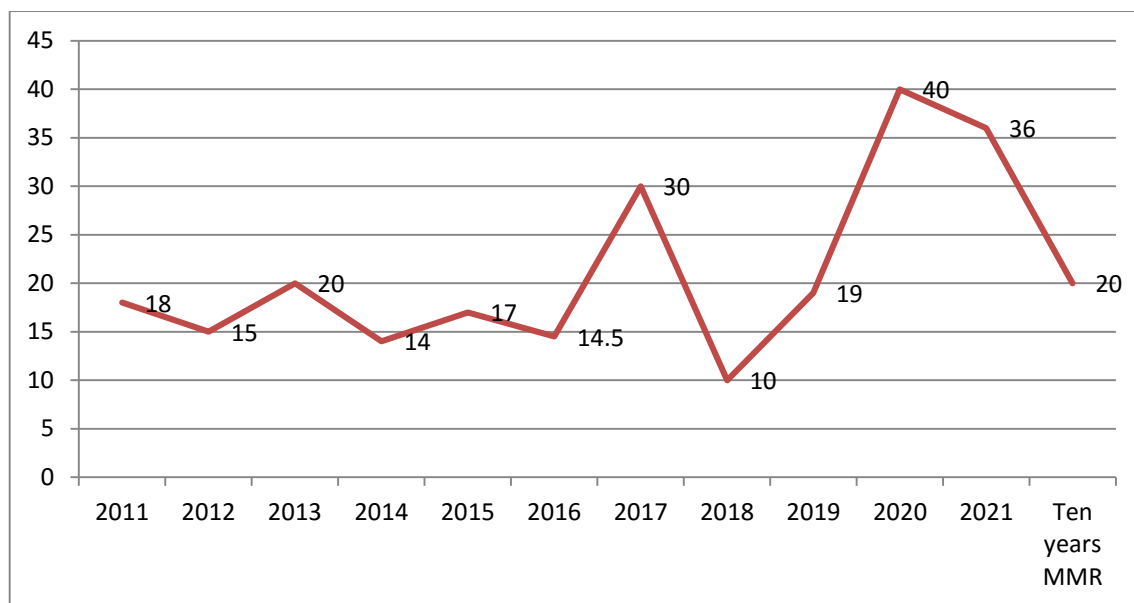
Figure 1. Year-wise distribution of MMR.

Discussion

The incidence rate and causes of maternal mortality is important because it is very closely reflects the effectiveness of health services, especially prenatal care. furthermore, maternal mortality often have adverse effects on family health and wellbeing, especially in less developed countries where child-rearing responsibilities rest on the woman in the household. In the less developed countries, maternal mortality is still high. What is tragic is that most of these deaths are preventable. Therefore, our study examined the maternal mortality rate and its causes among pregnant women in west Iran.

With regard to the distribution of the characteristics among the mothers; majority of the maternal deaths (30.4%) were occurred in the age group of 36 to 40 years. This, although, contrasted with the finding of Ezegwui et al. which reported that maternal deaths (27.3%) were common in the age group of 25 to 29 years (13). Aboyeji et al. also indicated that maternal deaths were common in women who were 40 years and above (14). The highest mortality were seen in the primiparas (34.8%) followed by primigravida (30.4%). This is also in consonance with other researches (13, 15). Abdulla et al. reported that women in the age group 20-29 years and pluriparous had a

higher risk of maternal deaths (16). There is a need for specific care for these women so that the risks and complications common to them are forecasted and timely handled.

Our finding illustrated that 55.1% of maternal deaths were due to direct causes whereas 44.9% of deaths were due to indirect causes. Zalvand et al. indicated that the causes of maternal deaths in 69.9% and 20.6% of cases respectively were direct and indirect (17). Dadipoor et al. reported that 74% of the maternal mortalities in Iran had direct causes and remaining was due to indirect causes (18). Our results demonstrated that the leading direct causes of maternal mortality were obstetric hemorrhage (21.7%), pregnancy-related infection (20.3%), and hypertensive disorders (11.6%), and also the most common indirect causes of mortality were pulmonary embolism (13.0%), suicide (11.6%) and cardiovascular diseases (10.1%). In 2023, a systematic review by Khalili et al. reported that the leading direct and indirect causes of maternal mortality were hemorrhage, hypertensive disorders, and cardiovascular diseases (12). Likewise, Bailey and colleagues illustrated that hypertensive disorders and hemorrhage were the predominant causes of maternal death in 40 low- and middle-income countries (19). Similarly, Banaei et al. in 2020 (20) and Barzegar et al. in 2019 reported that

pregnancy-related infection was still one of the most prevalent causes of maternal death (21). As well, 31% of all causes in Zalvand's study (17) and 35% in Dadipoor's study (18) showed that hemorrhage is the leading cause of maternal death in Iran. Agan and coworkers from Nigeria found that obstetric hemorrhage was responsible for about 32% of maternal mortality (22). Abdulla et al demonstrated that deaths attributed to hypertensive disorders, are the first leading cause of death (27.3%), and nearly double than hemorrhage (16). Moreover, Moazzeni et al. have illustrated that the leading causes of maternal mortality in Iran is shifting from those more reported in less developed countries like infection and hemorrhage to those are more prevalent in developed countries such as pulmonary embolism (23). Nevertheless, no in-depth study has evaluated the reasons why, despite many interventions performed in Iran, hemorrhage is still the predominant cause of death. However, Safari et al. reported that the possible explanations that lead to hemorrhage and maternal mortality in Iran included: doctor's delayed decision-making, delayed transfer to primary care center and emergency care (24). Say et al. stated that another description for the persistence of hemorrhage as the main cause of death is increasing rates of caesarean section, which is comprised half of all the deliveries in Iran (25).

We reported a higher frequency of maternal death among women who referred to the hospitals (89.9%), and those who deliver by caesarean section (52.2%). The mode of delivery responsible for the highest percentages of maternal mortality was caesarean section with a value of nearly 28% (13). We propose that the women who seek care in a hospital are experienced pregnancy complications that have required a higher level of medical care. This hypothesis is consistent with previous survey that shows the largest proportion of maternal mortality occur in hospitals where the higher risk patients are treated and where complicated patients are referred (26). We do not have data on the quality of care that was presented to these women or at what point in the mother's illness she arrived at the hospital for care.

Our study showed that most of the maternal deaths occurred post-delivery (69.6%); suggesting postpartum maternal care needs to be improved. Since hemorrhage was found to be a predominant cause of maternal death, mothers should be better monitored postpartum for this complication. This is comparable with most of the other studies. For instance, Khumanthem's survey in Imphal, India, reported postpartum deaths accounted for about 70% of maternal death and hemorrhage was the commonest cause of death (52.5 %) (27). The GBD study determinated that approximately a quarter of deaths occurred antepartum (24·6%), a quarter intrapartum and immediate postpartum (27·7%), a third delayed postpartum (35·6%) (28). The availability of blood banks at all first referral units and their timely functioning are suggested, this may save many lives.

In Kermanshah province, MMR has elevated from 18 deaths per 100 000 live births in 2011 to 36 in 2021, showing an increasing rate of about 100%. In our study, 75.4% of the mothers who died were experiencing a high risk pregnancy and approximately 42% had a history of a major chronic illness, showing the health system in Iran may not sufficiently prepared to meet the needs of an increasing number of pregnant women with high-risk pregnancies and comorbidities. Many diseases such as hypertension, kidney disease, and etc. increase the risk of maternal mortality during pregnancy.

Conclusion

The MMR during the period of the study elevated from 18 deaths per 100 000 live births in 2011 to 36 in 2021. Obstetric hemorrhage, pregnancy-related infection, pulmonary embolism were the significant cause of maternal death. Most contributory factors of maternal deaths in our state are preventable through combined safe motherhood strategies comprising focused antenatal care, prompt referral system, and

active management of labor. This study has suggested that mothers in the postpartum period need to be monitored more carefully, and especially for hemorrhage. Assessing the late maternal mortality (>42 days but<1 year) should be included in the future surveys.

Conflicts of interest

The authors declare that there they have no conflicts of interest. In addition, the authors have no financial interest related to any aspect of the study.

Authors' contributions

All authors were involved in the drafting of the manuscript and revising it critically for intellectual content, approved the final version for submission, and agreed to be accountable for all aspects of the work.

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