Original Article

Maternal Mortality Rate in Fars Province: Trends and Associated Factors in a Community-Based Survey

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Abstract

Background: The high rate of maternal mortality (MM) remains a challenge, especially in developing countries. In 2000, the World Health Organization (WHO) targeted a 75% reduction by the end of 2015. In this survey, we determine trends in MM rates and associated factors in Fars Province, southwestern Iran.

Methods: All MM in Fars Province from March 2003 to March 2010 were considered in this cross-sectional study. Data were recorded for demographic characteristics, autopsy findings, medical and obstetric histories. The data were then analyzed with a *z*-test to identify differences in the rate of MM during the study period.

Results: The mean MM rate was 22.18 per 100 000 live births (95% CI, 17.55–26.8) during the seven year study period, and was highest (32.3/100 000) in the first year. Most deaths (71.3%) occurred in the postpartum period, and the lowest proportion occurred during delivery (5%). High-risk mothers accounted for 79.2% of maternal deaths. Among the mothers who died, 62% received satisfactory prenatal care, and at least two years elapsed between successive pregnancies in 78%. Hemorrhage was the main cause of death (35.6%) and the least frequent cause was H1N1 virus infection (2%).

Conclusion: This study provides evidence of serious deficiencies in postpartum care that need urgent action. Priority should be given to vaginal bleeding and high-risk status mothers.

Keywords: Iran, maternal mortality

Introduction

Maternal mortality (MM) is a term used when a mother dies due to complications of pregnancy within 42 days after delivery.[1] It is estimated that over 500000 maternal deaths occur annually,[2] i.e., approximately one death per minute.[3] Overall, 15% of all pregnancies are complicated by mostly preventable and manageable obstetric conditions.[4] The main contributing factors of nearly 75% of maternal deaths are hemorrhage, infections, hypertensive disorders, obstructed labor, and unsafe abortion.[2,3] Other nonobstetric disorders that play a role in MM include severe anemia, sickle cell disease, and cardiovascular diseases.[3] Aside from medical causes, several nonmedical issues also play key roles in MM such as socioeconomic, cultural, religious, and biological factors (age and parity).[3]

The risk of MM is 200 times higher in developing countries compared to developed ones.[4] This is equal to 1 death in every 18 pregnancies, compared to 1 in every 2228 conceptions in developed countries.[5] Disparities in MM between developed and developing countries have highlighted the need for global attention to this important issue; therefore, the goal to achieve a 75% reduction in MM in all countries by the end of 2015 has been set as part of Millennium Development Goal number 5.[6] Since then, some progress has been made in developed countries; however, the problem persists in Asia and Africa, where the status is more hazardous.[7]

In Iran, a developing country in the Middle East region, maternal mortality rate (MMR) has fluctuated from 47.2 per 100000 live births in 1993 to 34.3 per 100000 in 1995, 45.7 per 100000 in 1997, 34 per 100000 in 1999, 38.7 per 100 000 in 2004 and 34 per 100000 live births in 2008.[8] Despite some overall progress in MMR trends, the rate is far from ideal and needs to be lowered. In this survey, we determine the most prevalent causes of MM in Fars Province (southwestern Iran) to provide a framework for identifying preventable causes of MM.

Patients and Methods

Design and setting

This community-based descriptive-analytic cross-sectional study of maternal deaths was conducted in Fars Province during seven years from March 21, 2003 to March 20, 2010. We selected this province because it has the fourth highest population in Iran, with about 1334046 women of childbearing age among a total population of 4500000. We used all maternal mortality cases, so sample size estimation was not required. Since burial permits are not issued for the deceased mother unless required by forensic study, we believe that all maternal mortality cases have been captured.

Local Ethics Committee approval was obtained. The cause of death for each case was recorded from the autopsy report and verbally from the woman's family. After a verbal explanation of the aims of our study, verbal consent to use this information was obtained from the woman's next of kin.

Data collection

Information regarding each case of MM was recorded by a team of trained experts who were members of the Maternal Mortality Committee. This team consisted of a gynecologist, an anesthesiologist, a midwife, a nurse, a coroner, a representative of the university Clinical Affairs section, and a representative of the Vice-

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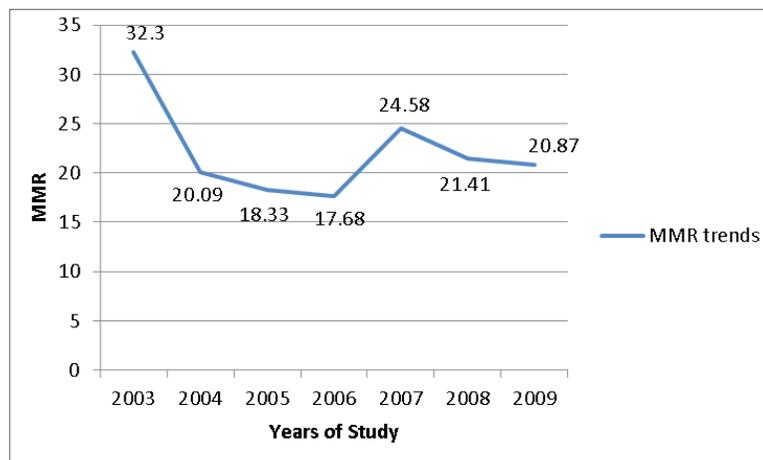
Figure 1. MMR trend from March 2003 to March 2010 in Shiraz, Fars Province, Iran.
MMR = maternal mortality rate [(Number of deceased mothers/Number of live births)*100000]

Chancellery of Health. They recorded the cause of death based on a review of available documents, i.e., perinatal care records, hospital admission files, verbal reports, and pathological autopsies.

Our data collection form consisted of two parts: demographic and obstetric. In the demographic part information such as the mothers' first and last name, date of death, hospital file code, residential area (urban, rural, and nomadic), age, and underlying diseases were recorded. Obstetric information consisted of past and present obstetric histories. From the past history we recorded information regarding the number of pregnancies, number of living children, and number of abortions. The present obstetric history comprised date of death, delivery or postpartum period, type of previous delivery (normal vaginal delivery, cesarean delivery or abortion), quality of prenatal care according to the attached prenatal care card, quality of care during labor (by reviewing the hospital file), and time between the two previous pregnancies in multiparous mothers.

Prenatal care was considered appropriate when it matched the standard of care, quantitatively and qualitatively. At least 14 care events during pregnancy are required for women with no medical or obstetric problems. Quality of care was categorized into appropriate or inappropriate according to follow-up, appropriate administration of drugs (if needed), supplements such as folic acid, iron, and multivitamins, and acceptable paraclinical interventions (lab tests and ultrasound examinations).

Care during labor and in the recovery room was considered appropriate if the type of drug, dosage, and time of administration were suitable, and if vital signs were recorded and acceptable measures were taken for those women who were unstable.

Our checklist for evaluating care during puerperium had two parts: quantity and quality. Mothers with no postpartum complications should be visited by an obstetrician or a midwife at least three times: the day after delivery, one week later and in the following six weeks. In these visits, mothers should be evaluated for any abnormal bleeding, infection, quality of married life, appropriate training for breast-feeding, and appropriate administration of supplements.

The Maternal Mortality Committee categorized deceased mothers into two groups: high-risk and low-risk. Mothers were considered high-risk if they met at least one of the criteria related to their age (younger than 19 or older than 34 years), presence of underlying diseases, or poor obstetric history. The poor obstetric history category included mothers with four or more previous deliveries, less than two years between pregnancies, or antenatal vaginal bleeding in the previous or present pregnancy.

Statistical analysis

The data were analyzed with a z-test to identify differences in the rates of MM that occurred between 2003–2010. Differences with a P less than 0.05 were considered statistically significant. The data are reported as mean ± standard deviation. All data were analyzed with SPSS v.15 software.

Results

Our community-based study revealed that in the previous seven years (2003–2010), the total MMR was 22.18 (95% CI, 17.55–26.8) per 100000 live births. Mean maternal age was 29.93 ± 6.6 years, ranging from 16 to 43 years. In the first year of our survey MMR was 32.3 per 100000 live births, followed by a decrease in the next three years. The lowest rate (17.68/100000) occurred in 2006. However, in the fifth year there was a slight increase (24.58/100000) followed by a second decrease. The MMR at the end of the study period was lower than in the first year. Although MMR had a clinically remarkable downward trend from 2003–2010 (Figure 1), there were no statistical differences detected in its occurrence during the study period ($P = 0.356$). Mean MMR was 26.5 per 100000 live births in mothers aged 18 years and younger, 17.1 per 100000 in those aged 19-34 years, and 62.6 per 100000 live births in women aged 35 years and over. The birth rates in these age groups were recorded by the Clinical Affairs section of Shiraz University of Medical Sciences.

Most deaths occurred during the postpartum period (71.3%), and 23.7% occurred in the antepartum period. Analysis of the quality of care revealed that almost 62% of the mothers who died had received appropriate prenatal care. According to the delivery room quality of care checklist, most mothers (95%) received appropriate quality of care during labor. Because no medical records were generated for postpartum care, we could not evaluate this period.

In our survey, 74.3% of the mothers who died were at high risk during the perinatal period. Table 1 compares demographic and clinical factors between high-risk and low-risk mothers.

Nearly 82.2% of the mothers died in hospitals or health facilities,

Table 1. Comparison of high-risk versus low-risk mothers in different subgroups.

Criterion	Frequency (%)	
	High-risk mothers	**Low-risk mothers**
Number (%)	80 (79.2%)	21 (20.8%)
Age groups		
18 years and below	4 (5%)	0
19-34 years	48 (60%)	21 (100%)
35 years and over	28 (35%)	0
Residential area		
Urban	41 (51.2%)	10 (47.6%)
Rural	36 (45%)	10 (47.6%)
Nomadic	3 (3.8%)	1 (4.8%)
Wanted pregnancy	59 (73.8%)	18 (85.7%)
Unwanted pregnancy	15 (18.8%)	2 (9.5%)
Indeterminate	5 (6.3%)	0
Death occurred in		
Pregnancy	19 (23.7%)	5 (23.7%)
Delivery	4 (5%)	1 (5%)
Post-delivery	57 (71.3%)	15 (71.3%)
Death occurred		
In the hospital or health facility	68 (85%)	15 (71.4%)
At home	4 (5%)	2 (9.5%)
During transportation	8 (10%)	4 (19%)
Spacing		
24 months or less	19 (23.8%)	3 (14.3%)
Over 24 months	61 (76.3%)	18 (85.7%)
Gravidity		
3 or less	50 (62.5%)	16 (76.2%)
More than 3	30 (37.5%)	5 (23.8%)
Vaginal bleeding	27 (33.8%)	9 (42.9%)
Infection	14 (17.6%)	3 (14.3%)

11.9% died during transportation to the health facility and 5.9% died at home. About 61.8% of the deaths occurred after cesarean delivery, 35.5% after normal vaginal delivery, and 2.6% after an abortion. Vaginal bleeding accounted for 35.6% of recorded causes of death, followed by postpartum sepsis (14.9%), eclampsia (10.9%) and pulmonary emboli (6.9%). It should be noted that H1N1 influenza accounted for 15% of maternal mortality (2/13 cases) in 2009, and for 2% of the overall MMR for the entire study period.

Discussion

The overall MMR of 22.18 (95% CI, 17.55–26.8) per 100 000 live births in our population was lower than the previously reported average MMR in Iran (25 per 100 000),[8] and much lower than the reported MMR in rural areas (34 per 10 000).[9] Our figure was higher than in some developed countries; however, the gap seems to be narrowing.[10,11] For example, the MMR in England was estimated at 15 per 100 000 deliveries during 2003–2005[10] and a study by Schutte and colleagues showed that in the Netherlands, MMR was approximately 12.1 per 100 000 live birth during 1993–2005.[11]

Iran's MMR is much lower than in other developing countries in Asia and Africa.[4,12] For example, in India MMR was estimated at about 519 per 100 000 live births,[4] and in northern Nigeria the figure was reported to be about 2849 per 100 000 deliveries over

a five year period from 2003 to 2007.[12] Differences in MMR between developing countries can be attributed to several factors including local topography, cultural factors, health resources, and quality of obstetric care.[3,12–14]

Between 2003 and 2010 the trend in MMR in our study population was generally downward clinically, with the lowest rate appearing in 2006, followed by a slight upward trend. At the end of the study period, MMR was lower than at the start of our study period. This tendency of MMR to fluctuate has been observed in other countries, such as the Netherlands and the UK.[11] According to Schutte and colleagues, changes in MMR may reflect better registration and data recording along with demographic changes, with age and parity playing the largest roles.[11] A correlation between MMR and maternal age is consistent with findings reported by Venn and colleagues, who have shown that older mothers need higher rates of assisted reproduction, which might contribute to higher MMR.[15] Pregnancy-related complications, another important factor, are more frequent in older women who are more often considered at high risk.[16]

The highest MMR was seen in mothers who were 35 years of age or older, whereas the rate in women aged between 18 and 35 years was much lower. Kullima and colleagues found significant differences in mortality rates among different age groups[12]; however, Schutte and colleagues found no such differences.[11]

In our study population most deaths occurred during the postpartum period, followed by pregnancy, and were less frequent during

labor. Although Bashour at al. found labor to be the most critical time followed by the postpartum period,[17] other studies such as ours found the postpartum period to account for the most maternal deaths.[2,18] One of the most important reasons may be the lack of adequate follow-up care during puerperium, a phase as important as pregnancy or labor. In this survey, care during puerperium was not documented in the medical record, so we were unable to evaluate the quality of care in comparison to pregnancy and labor. This was a potential limitation in our analysis. Good care during the prenatal period and labor did not necessarily result in a better delivery outcome. Almost all mothers who died (97.3%) received the full package of prenatal care and 95% received good care during labor. We suggest that the quality of postnatal care is as important as care during pregnancy and labor in preventing maternal deaths.

We found hemorrhage to be the main cause of maternal death, followed by eclampsia, sepsis, and emboli. Few studies have identified other main causes of maternal death in developed countries.[11,12] For example Schutte et al. and Kullima et al. reported that the most common causes of MM were pre-eclampsia and eclampsia, respectively.[11,12] Overall, our results were congruent with most studies in developing countries.[4,13,14,17,18] In some settings, the main cause of death and the order of relative contributions of different causes were the same as in our population. Like us, Gupta et al. and Tsu et al. found postpartum hemorrhage and eclampsia to be the two leading causes of maternal mortality.[4,18]

Cesarean delivery was involved in more than half (61.8%) of maternal deaths in our setting. This was not unexpected, because in Fars Province as in other developing areas, more than half of all deliveries are cesarians.[19,20] In addition, cesarean delivery is the procedure of choice in most high-risk pregnancies.[21] In our survey, 75% of the mothers who died were identified as high-risk. In the study by Schutte et al., 49% of the mothers who died had undergone cesarean delivery, although this mode of delivery was the direct cause of death in only four cases.[11]

Several limitations might affect our data and analysis. The most important limitation was our retrospective design and use of previously recorded data. Because our study design was cross-sectional, we could not identify predictors of maternal mortality based on our findings.

On the other hand, using community-based data for the entire Fars Province helped ensure the reliability of our analysis. We considered all maternal mortality cases recorded by an expert team and the Maternal Mortality Committee, thus the likelihood of information bias was reduced. The prolonged study period ensured that the trends we found in MMR were accurate. The size, demographic and ethnic diversity of our study population mean that our findings may be applicable, with appropriate reservations, to the general population of Iran.

This study identifies several points that are critical for health policy makers who aim to decrease MMR. We also highlight the need to focus on and document the quality of postpartum care, which is as important as prenatal care. Efforts to decrease MMR should focus on high-risk mothers not only during pregnancy and delivery but also during the postpartum period. Because vaginal bleeding was the most frequent cause of death in our setting, closer postpartum surveillance to detect this potentially worrisome complication is warranted.

Author disclosure statement

The authors declare that they have no competing financial interests.

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