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Research Article

Factors Contributing to Pregnant Mothers' Mortality in Golestan Province in Iran: A cross-sectional survey

Shima Rahimian[*1], Soheyla kalantari[2], Mohammadreza Mohammadi[3], Ameneh Kamalqaribi[4], Mohammadali Vakili[5] and Seyyed-Mohsen Hosseininejad[6]

[1]Msc in midwifery, Golestan University of Medical Sciences, Gorgan,Iran.
[2]Faculty member of Paramedical school, Department of surgical technology,
Golestan University of medical Sciences, Gorgan, Iran.
[3]Asistant professor Golestan University of Medical Sciences, Gorgan,Iran.
[4]Bs in midwifery, Golestan University of Medical Sciences, Gorgan,Iran
[5]Health Management and Social Development Research Center,
Department of Health and Social Medicine, Golestan University of Medical Sciences, Gorgan, Iran
[6]Medical Student, Student Research Committee,
Golestan University of Medical Sciences, Gorgan, Iran
*Corresponding Author: Shima. Rahimian, Deputy of Treatment,
Golestan University of Medical Sciences, Gorgan,Iran.
Tel: 09126884817 E-mail address: shima.rahimian@gmail.com

Short title: Maternal Mortality Survey in Golestan, Iran

ABSTRACT

Objective: We sought to determine the causes and characteristics of maternal deaths which occur in health faciliti es in Golestan province in Iran during 2006 to 2012.
Methods: Sixty maternal deaths were reviewed in 15 hospitals in 3 districts in Golestan province in Iran over a 7-year period. Causes and avoidable factors of maternal deaths were identified during the review and calculated acc ording to Poison model, and recommendations were made and implemented.
Results: There were (53.3 %) direct obstetric deaths and (34.9%) indirect obstetric deaths. The major causes of m aternal deaths were hemorrhage (43.75%), cardiovascular disease (21.87%). There was a statistical significant rela tionship between the ethnic groups and risk of mortality (p = 0.001). The leading causes of maternal death were di vided into 3 groups as follow: 1) Factors related to health systems (80 %), 2) factors outside the organization (10.3 8 %), and 3) patients / family factors (9.6 %). Most of the health system factors were divided into five categories i ncluding specialists' (31.8 percent), health worker factors (19.8 percent), prevention system' problems (16.15 perc ent), management' problems (8.8 percent), problems in admissions and emergency department (3.4 percent).
Conclusion: It seems necessary to consider preventive measures for more precise control during pregnancy and c hildbirth via increasing skills and knowledge of personnel and training efficient people about obstetric emergency, fast providing of blood products, improving emergency services, and providing a situation for referring to speciali zed equipped centers.

Keywords: Maternal mortality, Pregnancy, Risk factors, Clinical audit review, Iran

INTRODUCTION

Women's health and health indicators promotion play an important role in a country's health statu s (1). Investing in women's health is a fundamen tal human right (2) because of its role for develo ping social, economic, cultural and educational f actors (1), therefore attempt to increase their hea lth level is a priority for health programs (1-2). A survey of maternal mortality can save

the lives of mothers and babies; it can also reduce the burden of severe complications as well as improving access and care quality for pregnant women and their newly delivered babies (3). Numerous studies showed that only 53 percent of women in childbirth are supported by a high skilled person in developing countries (4). According to a report by World Health Organization (WHO) in 2013 year, 289,000 deaths approximately occurred worldwide that has decreased 45% compared to year 1990 (5). Studies present that the risk of maternal death in developing and undeveloped countries in pregnancy is 200 times more than developed countries (6) in the way that the risk of death during pregnancy or after childbirth is 1 to 6 in the poorest countries of the world compared to the northern Europe that is 1 to 30000 (4) that is 23 to 100000 live births in Iran based on deaths recorded by WHO in 2013 (7); while the aforementioned index is approximately 7.18 to 10 0000 live births in Golestan Province. In the vast majority of developing countries, pregnancy complications and childbirth are the leading causes of death, disease, and disability in women, and it has also caused 25 to 33% of deaths in this group up (8). Then, nowadays, index of maternal deaths due to pregnancy and childbirth complications is one of the most important indicators of the society development and its reduction is also a significant obligation of countries (8).

Reducing maternal mortality is one of the MDGS from years1990 to 2015 (9); moreover, reducing maternal mortality by 18 to 22 per hundred thousand live births is the Fourth Development Plan objectives associated with maternal health in Iran (8). To prevent further deaths, knowing the number of maternal deaths is not enough and it is necessary to identify the factors that led to their death (10). WHO estimates that 80 % of maternal mortalities are directly resulted by obstetric causes, mainly hemorrhage, infections, hypertensive disorders, complications in childbirth and abortion problems (2). With regards to the International Classification of Diseases (ICD), maternal deaths may be directly related to obstetric causes (as a result of complications during pregnancy, delivery and parturition course caused by treatment, negligence in treatment, inappropriate treatment) or may be associated with indirect obstetric causes of the current or during pregnancy disease that is not related directly to pregnancy and has worsened due to physiological effects of pregnancy (2). Every maternal death is an experience that can help us to identify problems and its treatment (10), because more than 80 percent of these deaths can be prevented by improving access to facilities, skilled attendance at birth, and timely emergency care (11). Studying and identifying the leading factors of mother death provide beneficial ideas to identify and overcome obstacles as well as providing secure care of pregnant women in the future (3); thus, it can be considered as a monitoring tool for the quality of prenatal care and reduce maternal mortality (12). Maternal mortality audit is one of the methods to improve the quality of women care that can be done in three ways as follow: 1) confidential questionnaire on maternal mortality done in three ways as follow: 1) confidential questionnaire on maternal mortality (CEMD[1]), (2) study the cause of death based on the facilities, and 3) evidence-based review of the cause of death (oral autopsy) (12) in the way that maternal deaths survey is based on facilities is a training process for specialists and health care workers of women during pregnancy, childbirth, and the postpartum period (13). Population distribution, special features of counties and different ethnic groups have led to different disparities in indicators of health program particularly mothers program. Then we are not able to introduce a single problem as the main one for mothers in Golestan Province and it is also necessary to identify problems and their interventions for all counties, exclusively. Then the current study was aimed to explore the mother mortality cause in Golestan Province during 2006 to 2012 years.

SUBJECTS AND METHODS

Study design

A cross-sectional study was commenced and conducted between February 2014 and August 2015 Gorgan, Iran. The protocol was approved by Research Committee (no 921017173) of Golestan

[1] confidential enquiry into maternal deaths

University of Medical Science. All records of deaths of 60 mothers were selected and explored from the first day of pregnancy up to 42 days after birth; all of this information was collected using death registration system in different counties and reports by health centers and all hospitals across the province.

Subjects

Inclusion criteria were as follows: 1) women with records in the registration system, 2) pregnant women followed by exclusion criteria as non-Iranian mothers. Overall, 60 eligible samples were investigated.

Instrument

Data were collected applying standard patient' sheet provided by Iran Ministry of Health and interviewing conducted by experts those working on Deputy of Health and Treatment as well as meeting of Experts Council and Committee of mother death. Questionnaires were completed by the telephone or in-person interviewing with their family due to partial completion. Questionnaires included two parts: 1) personal information such as age, date of death, place of birth and residence, and 2) information toward pregnancy and childbirth including time between two recent pregnancies, time of death (during pregnancy, childbirth or postpartum), gestational age at time of death, kind of pregnancy (intentional or unintentional), method of delivery, disease and illness and cause of death. In the case of incomplete records, researcher completed questionnaires after interviewing with telephone, visiting the address and contacting number that was listed in the records. The leading causes of maternal death were investigated by experts in maternal mortality those worked in Deputy of Treatment. In the next phase, mother death was categorized into two groups including pregnancy-related death (direct death) and pregnancy-unrelated death (indirect death). The number of live birth was collected using Golestan Registry Office in accordance with information acquired by Deputy of Health and census in the Golestan province. Maternal death was assessed through proportion of maternal deaths to live births of hundred thousand per year and a 7 years period and was also reported by point estimate and confidence interval 95 %.

Data analysis

Descriptive analysis was performed to describe the mean and standard deviation of the demographic characteristics. Poison model was used to conduct interval estimation of maternal mortality ratio assuming compliance with the number of observed deaths. Data were finally analyzed using SPSS statistical software (version.16) and STATA (version.10). Significant level was also considered <0.05.

RESULTS

With regards to the 7-year period examined from 2006 to 2012, 255788 live births and 60 maternal deaths occurred, then mothers mortality rate was calculated 23.46 per hundred thousand live births. The most deaths occurred in 2009 years with 35.79 per hundred thousand, and the lowest deaths happened in year 2010 with 10.88 per hundred thousand live births. In overall, 60 cases of maternal deaths were caused by direct maternal deaths 53.3 % (32 cases), indirect maternal deaths 35 % (21 cases), and unknown deaths 11.7 % (7 cases). The mean age of died mothers was 29 ± 6.44 years ranged from 15 to 43 years.

Direct maternal mortality caused 32 deaths including hemorrhage with 14 cases (43.75%) and cardiovascular disease with 7 cases (21.87 %) (Table 1), while indirect maternal mortality resulted in 21 deaths (35 %) that Influenza type A with 6 cases (28.6 percent) was the most leading factor (table 2). The most and lowest deaths occurred in the second and fourth pregnancy as 17 cases (28.3 %) and 9 cases (15 %), respectively. In total, 83 % of pregnancies were intentional; moreover 53.3 % and 35% of deaths happened during the post-partum and pregnancy, respectively. In the kind of delivery method, caesarean and natural childbirth accounted for 53.84 % and 46.15 %, respectively. Based on ethnicity of died mothers, 31 cases (51.7 %) were Turkmen, 14 cases (23.3 %) were Sistani and 9 cases (15 %) were Fars. Results found a significant relationship between the ethnic groups and mortality rate ($p= 0.001$). The risk of death in Turkmen women was 2.2 times more likely than other ethnic groups. Also 68.3 % lived in rural areas.

In the current study, the leading causes

of maternal death were divided into 3 groups as follows: 1) problems related to health systems (8 0 %), 2) problems outside the organization (10.3 8 %), and 3) factors in line with the patients and their families (9.6 %).

Most of the health system problems wer e divided into five categories including specialis ts' (31.8%), health worker factors (19.8%), preve ntion system' problems (16.15%), management' problems (8.8 %), problems in admissions and e mergency department (3.4 %).

Table 1. Frequency of direct causes of maternal mortality

Cause of death		Number	Percent (total deaths)	Percent (in related gro up)
Indirect cause	Addiction	2	3.3	9.5
	Brain problems	2	3.3	9.5
	Autoimmune	1	1.7	4.7
	H1N1 Flu	6	10	28.6
	Drug sensitivity	1	1.7	4.7
	Cancer	2	3.3	9.5
	Digestive problems	3	5	14.28
	Kidney problems	1	1.7	4.7
	Unknown fever	3	5	14.28
Total		21	35	100
Direct cause	Preeclampsia	3	5	9.37
	Cardiovascular problems	7	11.66	21.87
	Hemorrhage	14	23.33	43.75
	Lung embolism	5	8.33	15.62
	Septic shock	3	5	9.37
Total		32	53.3	100
Known cause		7	11.6	

Table 2. Interval estimation with Poisson model

Studied years	Number of birth	Number of death	Mortality rate per 100000 live births	Lower limit in 10 0000 live births	Upper limit in 100 000 live births
2006	34252	5	14.59	4.74	34.07
2007	34615	12	34.66	17.91	60.56
2008	34457	7	20.32	8.17	41.86
2009	36313	13	35.79	19.06	61.22
2010	36743	4	10.88	2.97	27.87
2011	39154	8	20.43	8.82	40.26
2012	40254	11	27.33	13.64	48.49
Total	255788	60	23.46	17.9	30.19

DISCUSSION

Low quality and validity of data in developing a nd low-income countries can be mentioned as th e main problems to implement a survey in the w ay there are many errors in recording and reporti ng that may affect quality of mother's death. Afo rementioned errors might be resulted by deleting information, reporting errors, interpretation erro rs and errors caused by inadequate organization of patient records as well as reporting errors that maternal death review process is a way to addre ss these problems. In reviewing maternal deaths during 2006-2012, 255788 births and 60 matern al deaths occurred, and then maternal mortality was 23.46 per 100000 of live births in Golestan province, on average. These mortalities were lo wer than national average with a number of 26 p er 100000 of live births at the same time (14, 15) . This information is better compared with some developing countries such as Afghanistan (543), India (230), Indonesia (217), Bangladesh (210) a nd Pakistan (197) and is worse compared to som e developed countries such as France (11), Germ any (7) and Spain (5.3 per hundred) (5). Accordi

ng to numerous studies, mother's death was 44, 31 and 25 per hundred thousand in years 2000, 2005 and 2010 respectively, which might be concluded that in our country, Sensitizing authorities, improving health care, improving quality of care and services in recent years, increasing the level of women's education and their active participation in social programs and improving roads status had a significant role in reducing deaths of pregnant women; however, we face a more difficult situation compared to countries including Saudi Arabia (17), Turkey (23) and Chile (24 per hundred thousand) (5), as mentioned above, more try and track is required.

Maternal mortality rate was 11.7, 10.3, 6 and 5.6 per hundred thousand in Canada, England, Japan and Australia, respectively that indicate that pregnancy and childbirth complications also observed in developing countries and its lower rate is because of timely treatment of mortality and more facilities (16). The most frequent causes of death related to pregnancy and childbirth are prioritized as hemorrhage, cardio-vascular and lung diseases as well as embolism. Although results of the current survey reported postpartum hemorrhage as the most important cause of death as the study implemented during 2001 to 2007; however, preeclampsia as the second leading cause of maternal mortality during 2001 to 2007 is replaced by the cardiovascular disease and is also ranked fifth in maternal mortality in Golestan province. With regards to the World Health Organization (WHO) report in 2014 year, six direct causes that led to 75 percent of maternal mortality included hemorrhage (27%), pregnancy hypertension (14%), infection (11%), hard labor (9%), unsafe abortions (83%) and embolism (3%)(17). In a study conducted by ministry of health in a period of 5 years (2009-2013 years), the most common cause of maternal mortality were hemorrhage (22%), preeclampsia (13%), cardio-vascular disease (10 %) and embolism (9%) (14-15). According to the Health Organization of mother and child in 2008, hemorrhage is the leading cause of maternal death in the United Kingdome and is also the most important single cause of half of all deaths after childbirth in developing countries (18). In Gabriel et al. study conducted in Ghana (2012) and Hofman et al. survey implemented in Malawi (2009), 22.5 % and 25.5 % of deaths are caused by hemorrhage respectively (13), while, the most common cause of maternal death has been reported pulmonary embolism, eclampsia, preeclampsia, indirect causes of deaths and hemorrhage in developed countries (20). Since most deaths occurred due to postpartum hemorrhage, some factors should be considered such as preventive measures to control hemorrhage after delivery by increasing the skills and knowledge of trained personnel and by training efficient forces in obstetric emergencies, rapid providing of blood products, improving emergency services and providing equipped centers. In this study, cardiovascular disease was also the second main cause of maternal mortality. Zollner (2012) mentioned maternal mortality caused by cardiovascular disease as 1 % across the world (21) that is significantly different compared with Iran Ministry of Health report in a study (10%) executed in 5 years (14, 15). Zollner also showed that cardiovascular disease accounts for 3.9 % of deaths in developing countries (21). In an investigation performed in developing countries by Jastrow, cardiovascular diseases are becoming as one of the primary causes of maternal mortality (22). Then it probably seems useful to assess all women before and during pregnancy by a multidisciplinary team with the goal of improving clinical status, change of treatment to avoid teratogenic medications and counseling the patient and his relatives about the potential risks and possible complications (22). Suitable diagnostic system for early diagnosis, appropriate referral to specialized centers and timely delivery with multidisciplinary support can decrease serious consequences of uncontrolled cardiovascular disease during pregnancy (23). In this study, a greater percentage of death cases and termination of pregnancy was caused by caesarean section. In a study conducted in England, the risk of maternal mortality in cesarean is three times higher than vaginal delivery (24). In Steven and Clark study in United States (2008), a relationship was observed between maternal death in vaginal delivery and total cesarean, primary cesarean and duplicate cesarean ($p < 0.001$). Also comparing maternal mortality in prim

ary cesarean with repeating cesarean section sho wed a significant correlation between these two variables (p = 0.01) (25). High rate cesarean is a global problem, as studies in England, America and South America showed an increase in cesare an section (24, 26, 27), and in Iran, a rapid incre ase in the number of cesarean section has occurr ed in the last two decades, and it seems benefici al to reduce the tendency of cesarean deliveries and making some changes in culture in order to i ncrease interest in the physiological and analgesi c drug, safe deliveries at health centers and, in br ief, avoidance of unnecessary cesarean. Eugene et al. (2009) categorized problems of mother' de ath into 4 issues including 1) health care worker s (66.1 %), 2) patients and their families (22.8 %), 3) traditional labor (5.93 %) and 4) manageme nt problems (5.08 %) (12). In a study conducted by forensic Organization of Iran (2005), proble ms led to the mother death consisted of lack of p hysician experience (41.3 %), lack of blood prod ucts (23.6 %) and lack of equipment and access t o skilled personnel (17.6 %) (28).

Inadequate documents for some of moth ers during the pregnancy, partial answer from bi opsy and pregnant women referral to hospital aft er death due to the passive care in urban health c enters resulted in failure to recognize the exact c ause of death. It seems a plan to minimize these limitations helps to identify the causes and preve ntion of maternal death.

CONCLUSION

Workshops in order to improve technical skills a nd develop positive attitudes staff for reporting a nd recording maternal complications during chil dbirth, using medical commissions and monitori ng visits of specialists as well as providing guide lines to care pregnant women can reduce matern al mortality.

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