A systematic review of epidemiological, causal status and policy-making issues of maternal mortality in Iran

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ABSTRACT

Background: Maternal mortality rate is not only an indicator of the quality level of maternal care but also represents the socio-economic status of any country. Maternal mortality had a decreasing trend in Iran during the last 24 years. Since preventable maternal mortality rate should be decreased to zero by 2030, effective planning and management in this regard are more needed.

Aim: This study aims to review the maternal mortality status in Iran systematically.

Method: This systematic review was designed and conducted in 2016. The information was gathered from searching databases including PubMed, Cochrane, Elsevier, Scopus, and also national databases including SID, Medlib, MagIran, IranMedex, and IranDoc. The selected time interval for searching was the studies published between 1985

and 2016. Meta-analysis statistical methods were used to calculate the maternal mortality rate.

Result: There were 26 studies related to the study objectives were included and analyzed. The mean and standard deviation of the age of maternal mortality was estimated to be 30.8 ± 5.6 years. Of the 15 studies mentioning types of termination of pregnancy, they showed the maternal mortality rates of 44% in natural childbirth, 52% in cesarean section, and 4% during pregnancy.

Conclusion: This study emphasizes the importance of leading and guiding studies and knowledge management to complete the knowledge cycle for maternal mortality. Considering the disparities in regions, the interventions should take into account the socioeconomic factors as well as improving roads and transportation system and women literacy level.

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INTRODUCTION

The maternal mortality rate is not only an indicator of the quality level of maternal care but also represents the socio-economic status of any country.[1] According to the World Health Organization report, the global maternal mortality ratio was 216 deaths per 100,000 live births in 2015. In general, this ratio in the world was reported to be from less than 10 in developed countries (Greece 3, Sweden 4, and Australia 6) up to more than 500 per one hundred thousand live births in developing countries (Kenya 510, Somalia 732, and Afghanistan 396).[2] It is estimated that every minute one mother and every day 1600 mothers die from complications related to pregnancy and childbirth worldwide.[3] In low and middle-income countries, the risk of death due to complications related to pregnancy and childbirth during a woman's life is 1 in 76, while in industrial countries, it is 1 in eight thousand.[4,5]

Based on the World Health Organization (WHO), maternal mortality had a decreasing trend in Iran during the last 24 years. The maternal mortality rate declined from 120 in 1990 to 72 in 1995, 48 in 2000, 30 in 2005, and 25 cases per hundred thousand live births in 2015.[2,6] It has

succeeded in reducing maternal mortality and with an 80% maternal mortality reduction is the third prosperous country in this regard.[6]

Since preventable maternal mortality rate should be decreased to zero by 2030, effective planning and management in this regard are more needed. To do so, obtaining accurate and precise information on different aspects (epidemiological, managerial, policy, ecological, and other elements) of the maternal mortality issue is critical. Hence, review and analysis of studies conducted in this field can be helpful for cause detection and designing policy-making interventions. Thus, this study aims to review of the maternal mortality status in Iran systematically.

METHODS

This systematic review was designed and conducted in 2016. The strategies were using keywords obtained with Mesh and their Persian equivalents including "maternal health", "maternal mortality", "maternal death", "risk factors", epidemiology, prevalence, Iran. The required information was gathered from searching databases including

PubMed, Cochrane, Elsevier, Scopus, and also national databases including SID, Medlib, MagIran, IranMedex, and IranDoc. Google Scholar was also searched for final search completion. Websites related to maternal mortality, such as WHO, were also explored. In addition, hand searching, reference check of selected papers and contact experts in the field of maternal mortality were conducted to gather studies in this study. The selected time interval for searching was the studies published between 1985 and 2016. Inclusion criteria were: publication date of studies between 1985 and 2016; published studies in English or Persian; at least one maternal mortality aspect in Iran was mentioned; possibility to access the full text of the study; and observational studies.

Quality appraisal of studies

After obtaining all studies, using the keywords mentioned, from the desired databases, the quality of reports of all studies were assessed by two assessors using the STROBE (Strengthening the Reporting of Observational studies in Epidemiology) checklist (Annex 1). This checklist was essential for quality appraisal of the studies because of its specificity in assessing observational studies and the availability of its translation into Persian language and validation. The checklist includes 22 items. In this review, those studies without matching for at least half of the items (11 out of 22 items) were excluded.

Data extraction

Firstly, two data extraction forms were designed manually in Excel software. The first form was for epidemiological and causational studies and the extracted data in this form had two main parts. The first part comprised general information of studies, and the second part included epidemiological and causational information on maternal mortality in Iran. As a pilot data extraction, first, data of five studies were extracted into this form and existing defects and problems in the initial form were solved. The second form was also used for data extraction of other studies.

Data analysis

Meta-analysis statistical methods were applied to calculate the maternal mortality rate. As to conduct a meta-analysis, the Comprehensive Meta-Analysis (CMA) software Version 2 was utilized. Forest plots were designed to report results in which the size of each square shows the sample size and lines drawn in each side of the square that represents a 95 percent confidence interval for each study. Q statistic and I2 index were set to measure the heterogeneity of the results of studies. In this review, I2 ≥ 50% was determined as the criterion for heterogeneity of the studies. P-value < 0.05 was considered statistically significant.

RESULTS

Of 696 identified studies, 26 studies related to the study objectives were included and analyzed. The selection process of the reviews is presented in figure 1. Out of 26 assessed studies, 21 studies were related to epidemiological and causality of maternal mortality issues and only five studies assessed non-epidemiological aspects of the issue. The summary of epidemiologic and non-epidemiologic studies are provided in table 1 and table 3, respectively.

Among studies in the epidemiology field, the oldest one was published in 2002, and the highest number of published studies was in 2014 (6 studies). Regarding studied cities, countrywide data were used in 4 studies. There was a published study on maternal mortality in 7 provinces. The highest number of studies were conducted in provinces of West Azerbaijan, Ilam, Sistan and Baluchistan, and Kurdistan. Regarding study design, there were 14 cross-sectional, 3 case-control and four ecological studies. Data collection period varied from 3 to 12 years. Data recorded in healthcare networks, hospital records, and maternal mortality surveillance system were three primary sources of data collection. In non-epidemiologic studies, three studies were on managerial issues, one on methodology and only one study was on the policy-making point. All these five studies were published from 2011 onwards.

Regarding methods, there were three case-control studies, one qualitative and one mixed methods (quantitative-qualitative) study. Interestingly, the date of the investigation was not mentioned in three studies. Interview, observation, document review, and use of existing information were the most important sources of data collection.

Of 21 assessed epidemiologic studies, the age of maternal death was mentioned in 11 reviews, and in general, the mean and standard deviation of the age of maternal mortality was estimated to be 30.8±5.6 years. The educational level of died mothers was mentioned in 11 studies, and the results showed that on average 45 percent of died mothers were illiterate. Results of 15 studies citing the place of living (rural, urban and tribal) of died mothers showed that 56.1% of them lived in rural, 43.1% in urban and 0.8% in tribal areas. Independent samples test showed no significant difference between maternal mortality and living in urban and rural areas (p>0.05). Results of 13 studies mentioning the place of mothers' death (hospital, home, on

Table 1 Summary of the results of non-epidemiologic studies son maternal mortality in Iran

Author	Publish year	City	Study design	Data collection /time	Data collection/ tool and source	Study field	Overall results
Zolala and Haghdoost[7]	2011	Kerman	Qualitative study	NM	In-depth interviews, documents assessment and observation	Health policy	T practice which can be explained by inadequate training programs, inadequate collaboration and shortage in sufficient guidelines and instigation of a specific investigation into maternal deaths
Yazdizadeh et al.[8]	2014	Overall of Iran	Cross-sectional	2004 and 2005	Capture-recapture (CRC)/ maternal mortality surveillance system(MMSS) and the National Death Registry	Methodology (Health Information System)	The MMR estimation by CRC method is slightly different from the international studies.
Beigi et al.[9]	2015	Isfahan	Cross-sectional	2013-2014	Files in the maternal health center and the interviews conducted with relevant personnel/ researcher-made a checklist	Management	Based on the RCA process, the most fundamental factor in creating these deaths was management errors at the level of universities and the Ministry of Health
Mobasheri et al.[10]	2013	Markazi	Cross-sectional	NM	Interviews and documents' investigation, and Bayesian analysis and calculation of conditional probability	Management	According to root cause analysis, indirect causes had a 43% contribution to the mother's death
Rahimi et al.[11]	2012	Overall of Iran	Miex methods	NM	Questionnaire and interviews	Management	All three steps of the system are moderately good in their opinion. Mean score in the implementation of intervention (59 from 100) was lower than designing intervention (63 from 100) and information collection (67 from 100).

the way to hospital and birth facilities) showed that the highest percentage of death took place in hospitals (Figure 2). The result of One Way ANOVA test showed the significant difference between places of mothers' death ($p<0.05$).

In this review, causes of maternal mortality were categorized into seven groups (bleeding, underlying diseases such as heart disease, abortion, embolism, eclampsia, infections, and other causes) and among them, bleeding was identified as the leading cause of maternal death. Of the 15 studies mentioning types of termination of pregnancy, they showed the maternal mortality rates of 44% in natural childbirth, 52 % in cesarean section, and 4% during pregnancy. Independent samples t-test showed a significant difference between natural delivery and cesarean section ($p<0.05$).

16 studies reported 21 factors to be significantly related to maternal mortality. Mother's literacy, quality of services (prenatal, intrapartum, postpartum), gestational age, kind of delivery, birth attendant and number of pregnancies were the most important.

Findings of other studies

Of 26 studies on maternal mortality in Iran, only five studies investigated (Table 3). Of these five studies, three studies were related to managerial problems, one study was about methodology, and only one study was on the policy-making issue. All these five studies were published after 2011. Regarding methods, there were 3 case-control studies, one qualitative and one mixed methods (quantitative-qualitative) study.
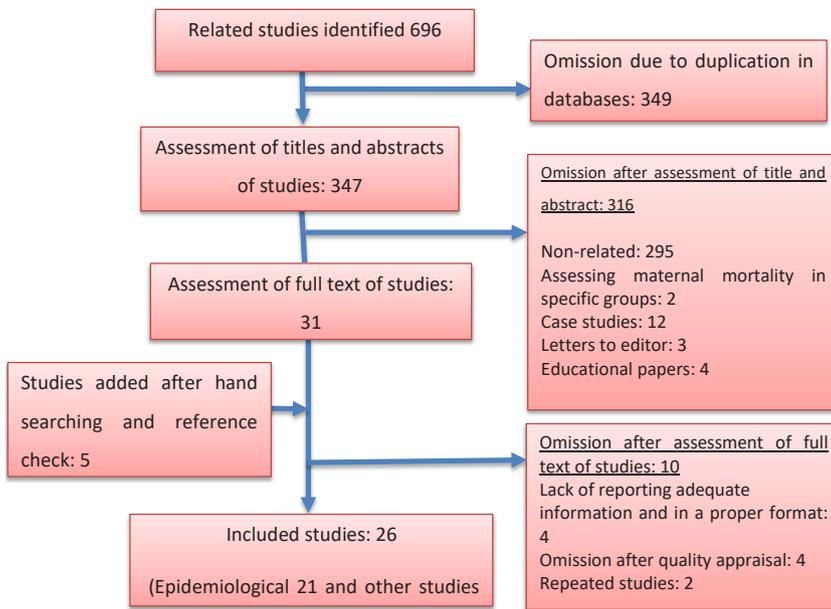
Figure 1 The selection process of studies

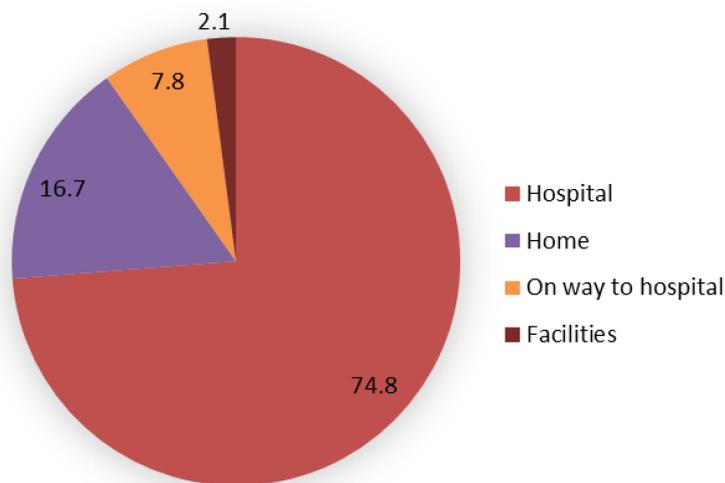**Figure 2** Percentage of maternal mortality based on place of death

that the maternal mortality rate using this method is different from available statistics and results of various studies.[8]

In two studies in the management field, Mobasheri et al. (2013) in the province of Markazi and Beigi et al. (2015) in the province of Isfahan determined causes of maternal mortality using Root Cause Analysis.[9,10] In other study in the management field, Rahimi et al. (2012) explored attitudes of headquarter employees and experts toward the implementation of the national maternal mortality surveillance system using questionnaire and interview. Results of the study showed that most of the employees held a fairly favorable attitude toward all three steps of information collection, design and implementation of the intervention. Weakness points mentioned by researchers and policymakers in the interview part included inappropriateness of questions about demographic information of deceased and household, difficulty of summarizing them, lack of proper segregation of different levels of medical staff on the need for training as well as the location of death (in the step of information collection), organizing committees as a formality (in the phase of the intervention design), and also the lack of interventions design or lack of proper implementation of interventions (in the stage of intervention implementation).[11]

DISCUSSION

In this study, the mean and standard deviation of the age of maternal mortality were estimated to be 30.8±5.6 years. Most of the studies in the world also showed that the risk of death among mothers higher than 30 years old is much higher. Maternal mortality curve in most of the countries in the world has a J-shape; i.e., maternal mortality at lower ages (usually under 18 years old) and higher ages (generally higher than 30 years old) is higher than 20 to 29 age groups. Results of the study conducted be Blanc[12] that assessed the age pattern of maternal mortality in 38 countries indicated the J-shape of maternal mortality age and maternal mortality rate among mothers at higher than 30 years old were reported much higher.

The results of the current study showed that on average 45 percent of died mothers were illiterate. In several international studies, a positive association was found between higher literacy rate of mothers and a reduction in maternal mortality.[13-18] According to the results of the study of WHO in 24 countries, the risk of maternal mortality was 2.7 times more in illiterate women than those having 1 to 6 grades education level and two times more than those with 12 grades education level.[19]

Interestingly, the date of the investigation was not mentioned in 3 studies. Interview, observation, document review, and use of existing information were the most important sources of data collection. Zolala and Haghdoost (2010) in their study on policy-making in mortality in Iran showed that there are large gaps between adopted policies in maternal mortality and implementation of them in Iran. The most important reasons include inadequate educational programs, lack of sufficient collaboration, and shortage within adequate guidelines and practical research in the field of maternal mortality.[7] Yazdizadeh et al. (2014) utilized the capture-recapture method to estimate the maternal mortality rate in Iran. Results of the study showed

Also, results of the study by Karslen[11] showed that grades of education prevent 2 cases of maternal mortality in 1000 mothers. Low educational level of the mother has an impact on maternal mortality through specific behaviors and actions. Among these behaviors marriage and pregnancy at an early age, the lack of proper spacing between pregnancies, lack of awareness of and attention to symptoms and risks during pregnancy, lack of a timely visit to receive health care and other unhealthy behaviors can be mentioned as the most important one.[19,20]

Based on the results of the current study, most of the maternal mortality occurred among mothers living in rural areas (56.1%). However, independent samples t-test showed no significant difference between maternal mortality and living in urban and rural areas (p>0.05). The higher rate of maternal mortality in rural areas was confirmed in several studies in the world.[21-23] The reasons mentioned in these studies were insufficient access to high quality and standard care during pregnancy in rural areas, delay in access to advanced delivery centers during childbirth, low education level, low level of health indicators and certain health beliefs.[24-28] The results of the current study showed that the majority of deaths occurred in hospital settings. However, it seems reasonable because of the high numbers of childbirths in hospitals. Referral of high risks pregnancies to hospitals or delay in taking pregnant mothers to the hospital could be the reasons.[29,30]

Regarding the causes of maternal mortality in this study, bleeding was always the first and most important cause of maternal mortality. Several studies at the national level and in other countries also indicated bleeding as a key factor for maternal mortality.[31-40] The results of the current study showed that the highest maternal mortality occurred in cesarean section (%52, P<0.000). Some studies also showed that cesarean section is a risk factor for maternal mortality.[41,42] Also, some studies showed that natural childbirth increased maternal mortality.[43,44] The result of a systematic review by Vadnais and Sachs showed no significant difference between the type of childbirth and maternal mortality.[45] The risk of bleeding, infection and thromboembolism was higher in cesarean section as well as it increases the risk of abnormal adhesion of embryo and uterus rupture in future pregnancies.[46]

Of the 31 provinces in the country, only in 12 provinces there were published studies on maternal mortality. The highest number of studies was in provinces of West Azerbaijan, Ilam, Sistan and Baluchistan and Kurdistan that seems reasonable due to the status of maternal mortality in these provinces. For instance, Sistan and Baluchistan province, with an average of 6.44 percent of all births in the country, had 14.27% of the total maternal mortality in the country (during five years 2010-2015). Its maternal mortality rate is three times of the average of country.[47] Its reason can be the low level of health indicators, poor quality of health care, inadequate access to health centers, low levels of literacy, adverse socio/economic condition and high fertility rates.[48,49] Political will, proper allocation of resources in the public sector, education and greater participation of the private sector are among the most important macro-structural factors associated with maternal mortality.[50] As to reduce inequity in maternal mortality, addressing regions with maternal mortality higher than the country average is among international strategies to achieve maternal health in sustainable development goals.[51]

Of the total selected studies in Iran, four studies investigated the association between receiving prenatal care and maternal mortality and one study assessed the relationship between quality of care and maternal mortality which reported significance. Consciously, maternal care has remained safe against the critical evaluation that all screening procedures exposed.[52] Based on the WHO systematic review, there is no reported difference between all mother and child consequences in various maternal care models regarding more or fewer frequencies.[53]

Proposed domain for further studies

Considering the existing gap between the average rate of maternal mortality in the country and the deprived areas, conducting studies assessing the impact of social factors on maternal mortality and producing evidence in this regard are of high importance to convince policymakers and result in planning at the macro level. The investigation of factors influencing the behavior of mother and her family in care seeking behavior and reasons for delay of the family to refer and barriers of receiving health service is critical issue. Given that the only existing study assessed the step of the establishment of policy, further research to investigate other stages of the policy-making cycle are among other gaps in this field.

CONCLUSION

The results of this study reveal the research gap in effectiveness and cost-effectiveness of interventions and a limited number of studies on management and policymaking. This study emphasizes the importance of leading and guiding studies and

knowledge management to complete the knowledge cycle for maternal mortality. As regard to the high maternal mortality rate in the deprived areas in the country, to address the inequity, planning should be conducted using the approach of the impact of socioeconomic factors, efforts to improve the transportation system, roads, women's education level, and infrastructures.

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