

# Systematic review and meta-analysis of maternal mortality ratio and related factors in the Islamic Republic of Iran

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## Abstract

**Background:** Maternal mortality is an indication of the health status of women in the society.

**Aims:** To investigate the maternal mortality ratio, causes of maternal mortality, and related risk factors among Iranian women.

**Methods:** Using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist and the Peer Review of Electronic Search Strategies (PRESS) guideline, we systematically searched electronic databases, and the grey literature, for publications in Farsi and English from 1970 to January 2022 for studies that reported the number of maternal deaths and/or maternal mortality ratio and their related factors. Data analysis was conducted using Stata 16 and 2-sided  $P \leq 0.05$  was considered statistically significant, if not otherwise specified.

**Results:** A subgroup meta-analysis of studies conducted since 2000 estimated the maternal mortality ratio as 45.03 per 100 000 births during 2000–2004, 36.05 during 2005–2009, and 23.71 after 2010. The most frequent risk factors for maternal mortality were caesarean section, poor antenatal and delivery care, unskilled birth attendance, age, low maternal education level, lower human development index, and residence in rural or remote areas.

**Conclusion:** There has been a significant decrease in maternal mortality in the Islamic Republic of Iran during the last few decades. Mothers in the country need to be monitored more carefully by trained healthcare workers during the pregnancy, delivery and postpartum periods so they can effectively handle postpartum complications, such as haemorrhage and infection, thereby further reducing maternal mortality.

Keywords: maternal mortality, maternal death, cause of death, pregnancy complications, Islamic Republic of Iran

Citation: Khalili M, Mashrouteh M, Haghdoost A, Torkian S, Chegeni M. Systematic review and meta-analysis of maternal mortality ratio and related factors in the Islamic Republic of Iran. *East Mediterr Health J.* 2023;29(5):380–401. <https://doi.org/10.26719/emhj.23.063>

URL for supplement to this article: <https://applications.emro.who.int/EMHJ/V29/05/1020-3397-2023-2905-Supplement-eng.pdf>

Received: 01/09/21, Accepted: 31/10/22

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## Introduction

Maternal mortality is widely used as a summary indicator to describe population health and socioeconomic development (1). WHO defines maternal mortality as “the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the cause of death (obstetric and nonobstetric)” (2). It has important negative social and economic consequences on society and families, especially on newborn babies and under conditions of socioeconomic deprivation (3,4). Maternal mortality ratio (MMR) is a key indicator of health and socioeconomic development that reflects the overall quality and effectiveness of health policies, quality of healthcare services, and women’s health status and life expectancy (5–7). MMR is affected by several factors, including educational level, rural road networks, access to midwifery services in an emergency situation, healthcare costs, telecommunication networks, household income, provision of health services, and reducing difficulties during pregnancy (8–12).

One of the United Nations Sustainable Development Goals is focused on improving maternal health to reduce MMR worldwide to < 70 per 100 000 live births by 2030 (13). There is increased political attention to how countries progress towards this target (14). Although MMR globally declined from 385 deaths per 100 000 live births in 1990 to 211 in 2017 (15), there are still global inequalities in achieving the target (16). There are considerable differences between regions regarding progress towards reducing MMR. According to the estimation of Alkema et al. for 171 countries, the highest annual decline in MMR was in East Asia (5%), and the lowest was in the Caribbean (1.8%) between 1990 and 2015 (17). MMR also decreased in most developed industrialized countries during 2000–2014 (18). Maternal mortality is higher in developing than in developed countries (19), and > 99% of these deaths occur in developing countries and most are avoidable (20).

The Islamic Republic of Iran is a middle-income country (21) with a population of ~84 million (49% female) (22), and it has achieved the fifth Millennium Development Goal to improve maternal health (23,24).

According to the latest WHO report, MMR in the Islamic Republic of Iran was reduced from 48 to 16 per 100 000 live births from 2000 to 2017, which indicates a nearly 6.3% annual reduction (25). According to the latest report by the Iranian Ministry of Health, MMR reached 17.7 deaths per 100 000 live births in 2018 (26). However, this figure is not sufficiently low compared with some developed countries (27–29). A systematic review in the Islamic Republic of Iran revealed that the leading causes of maternal mortality were haemorrhage, hypertensive disorders, and cardiovascular diseases (4).

Maternal mortality is indicative of women's overall status, access to health care, and responsiveness of the healthcare system to their needs. Therefore, knowledge of maternal mortality level is essential for determining complications during pregnancy and childbirth, as well as women's health and, indirectly, their socioeconomic status and inequity. Determination of MMR and its associated risk factors and causes of mortality is necessary for diagnosis and assessing the progress and effectiveness of existing programmes. Several Iranian studies have assessed MMR and the causes of maternal mortality, but they were not systematically evaluated and did not report an overall pooled estimate of MMR. Additionally, official reports of maternal mortality, produced annually by the Iranian Ministry of Health and WHO, are usually affected by under-reporting bias.

A valid estimate of MMR is crucial for effective policymaking, health programme decision-making, funding to control the problem, and supporting advocacy for pregnant women. Understanding the causes of maternal mortality and its associated risk factors are essential for reducing maternal mortality and adopting policies for care of pregnant women. Therefore, this systematic review and meta-analysis aimed to estimate the MMR and highlight the causes of maternal mortality and related risk factors in the Islamic Republic of Iran.

## Methods

### Search strategy

The details of the research questions, search strategy, study selection procedure, and analytical approach were designed *a priori* in an internal unpublished protocol before initiation of the review. Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist (Supplementary Table S1) and the Peer Review of Electronic Search Strategies (PRESS) guideline (30,31), we searched Web of Science, PubMed, Embase, Google Scholar, and Iranian scientific databases, including Scientific Information Database (<https://www.sid.ir/En/Journal/>) and Magiran (<https://www.magiran.com/>) from inception in 1970 to 16 January 2022, for studies that reported the number of maternal deaths, and/or MMRs and their related factors. We also searched the grey literature. Search terms were combined using appropriate Boolean operators and included subject

heading terms/keywords relevant to maternal mortality that were adapted for each database. The search strategy included both English and Farsi keywords. Our sample search strategy is shown in Supplementary Table S2.

### Inclusion criteria

We included quantitative studies in English and Farsi that reported the number of maternal deaths and/or MMRs among pregnant women at the national, provincial, and local levels. Studies investigating pregnant women with specific illnesses were excluded, given their different underlying conditions compared with the general population of pregnant women. Studies were included in the meta-analysis if they provided data on the number of deaths, live births, and standard errors. No ethical approval was required because this study used secondary data and involved no interaction with human subjects. Two authors independently completed the abstract and full-text screening. The full text of articles that met our inclusion criteria or were unclear were screened by 2 independent reviewers, and disagreements were resolved through discussion with the senior author. Duplicate records were excluded.

### Data extraction

Data were extracted independently by 2 authors, and discrepancies were resolved by a third author. The following information was extracted: authors, publication year, year of conducting the study, source of data, study duration, study design, age, MMR, number of maternal deaths, number of live births, maternal mortality risk factors, and causes of maternal mortality.

### Quality assessment

We used the Joanna Briggs Institute Critical Appraisal Checklists for methodological quality assessment based on the design of the included studies (32). This appraisal tool aimed to assess the methodological quality of the included studies and determined how each study addressed the possibility of bias in its design, conduct, and analysis. Selected studies were examined for representativeness, sample size, recruitment, description of the study participants and setting, data coverage of the identified sample, reliability of the measured condition (i.e. maternal mortality), bias, and adequacy of the statistical analysis. The methodological quality of the studies was assessed by two reviewers. Disagreements were resolved through discussions with a third author. The tool was modified to provide a numerical score (33, 34), and acquisition of more than half of scores was characterized as low/fair quality and lower than half scores as moderate/good quality.

### Statistical analysis

Studies conducted after 2000 were included in the meta-analysis. We used a random-effects model to pool data for MMRs across studies, which considered within- and between-study variability. The 95% confidence

interval (CI) was calculated for pooled MMRs during the study period. Heterogeneity between studies was assessed using both the  $I^2$  statistic with a cutoff of  $\geq 50\%$  and  $\chi^2$  test with  $P < 0.10$  to define a significant degree of heterogeneity (35). After observing substantial heterogeneity among the studies, meta-regression was performed to identify the potential sources of heterogeneity. The following variables were included in the model: study year/median study year, number of live births, and study location. Then, we performed a subgroup meta-analysis according to the study year/median study year (statistically significant variable in the meta-regression model). MMR for 2020 was estimated based on the adjusted regression coefficient for the study year obtained from the meta-regression analysis. We conducted a sensitivity analysis to assess the impact of excluding studies with outlier estimates on the pooled MMR. Stata 16 (StataCorp, College Station, TX, USA) was used for all the analyses and graphics. Two-sided  $P \leq 0.05$  was considered statistically significant, if not otherwise specified.

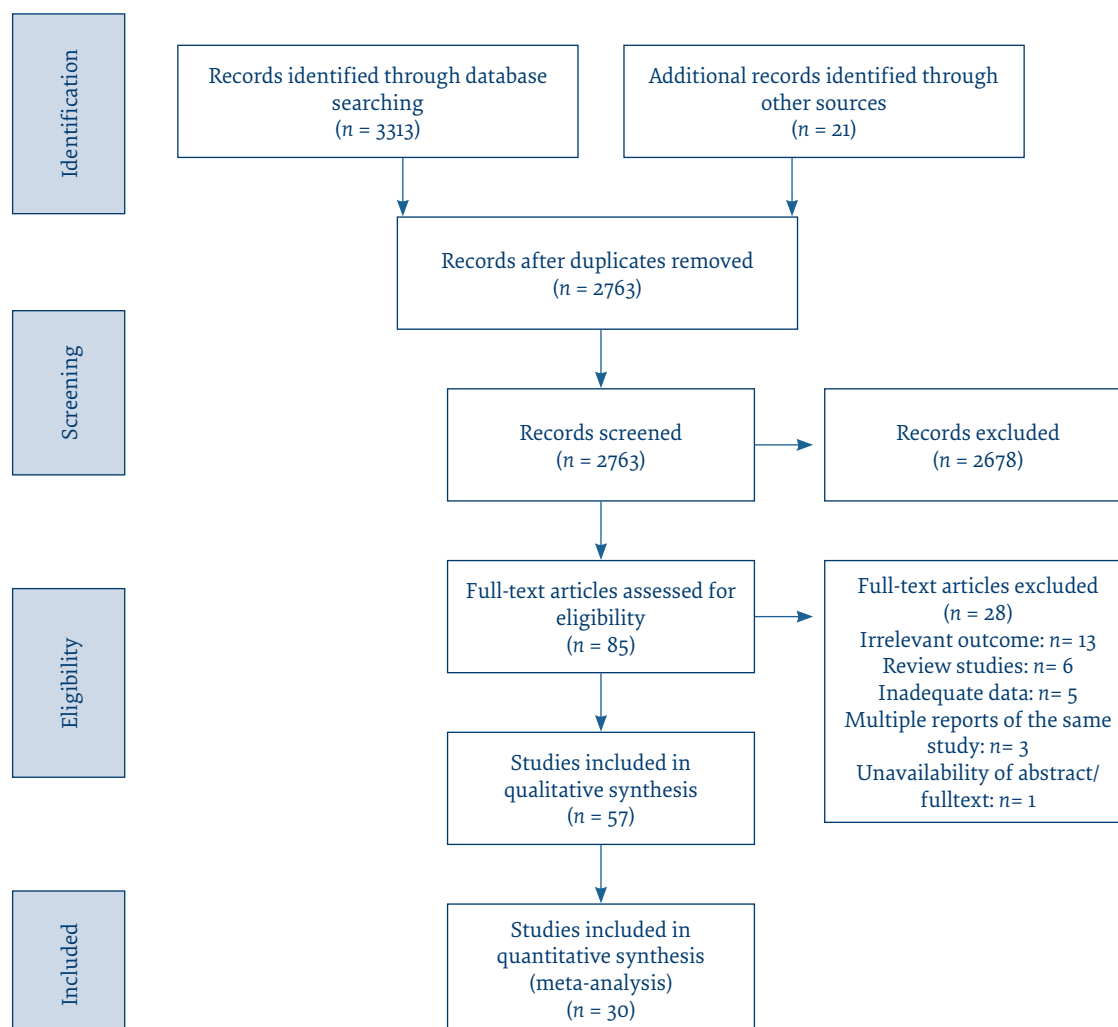
## Results

### Characteristics of included studies

We retrieved and screened 3334 papers based on title and abstract, and 3249 were excluded because they did not meet the inclusion criteria or were duplicates. Eighty-five papers were eligible for full-text review, and 28 of these were subsequently excluded (Figure 1). Finally, 57 papers were selected for the systematic review of maternal mortality, and 30 were used for meta-analysis of MMR. Twenty-seven papers were excluded from the meta-analysis and only presented in the systematic review, because they did not report sufficient data to calculate the standard error.

The main characteristics of the included studies are presented in Supplementary Table S3. The reviewed studies were conducted in different parts of the Islamic Republic of Iran from 1970 to 2021. Most of the included studies were cross-sectional or descriptive and of moderate or good quality. The study duration was from 2 months (36) to 27 years (24, 37). The mean maternal age was between 18.79 (1.27) (38) and 35.1 (6.4) (39) years.

**Figure 1** PRISMA flowchart of screened and included studies



Eleven (19.3%) studies were conducted at the national level, and 5 were carried out in Tehran Province and 5 in Fars Province. Almost all of them (24, 37–39) used the WHO definition for maternal mortality, and data from the Maternal Mortality Surveillance System were used in the majority of studies.

### Maternal mortality ratio

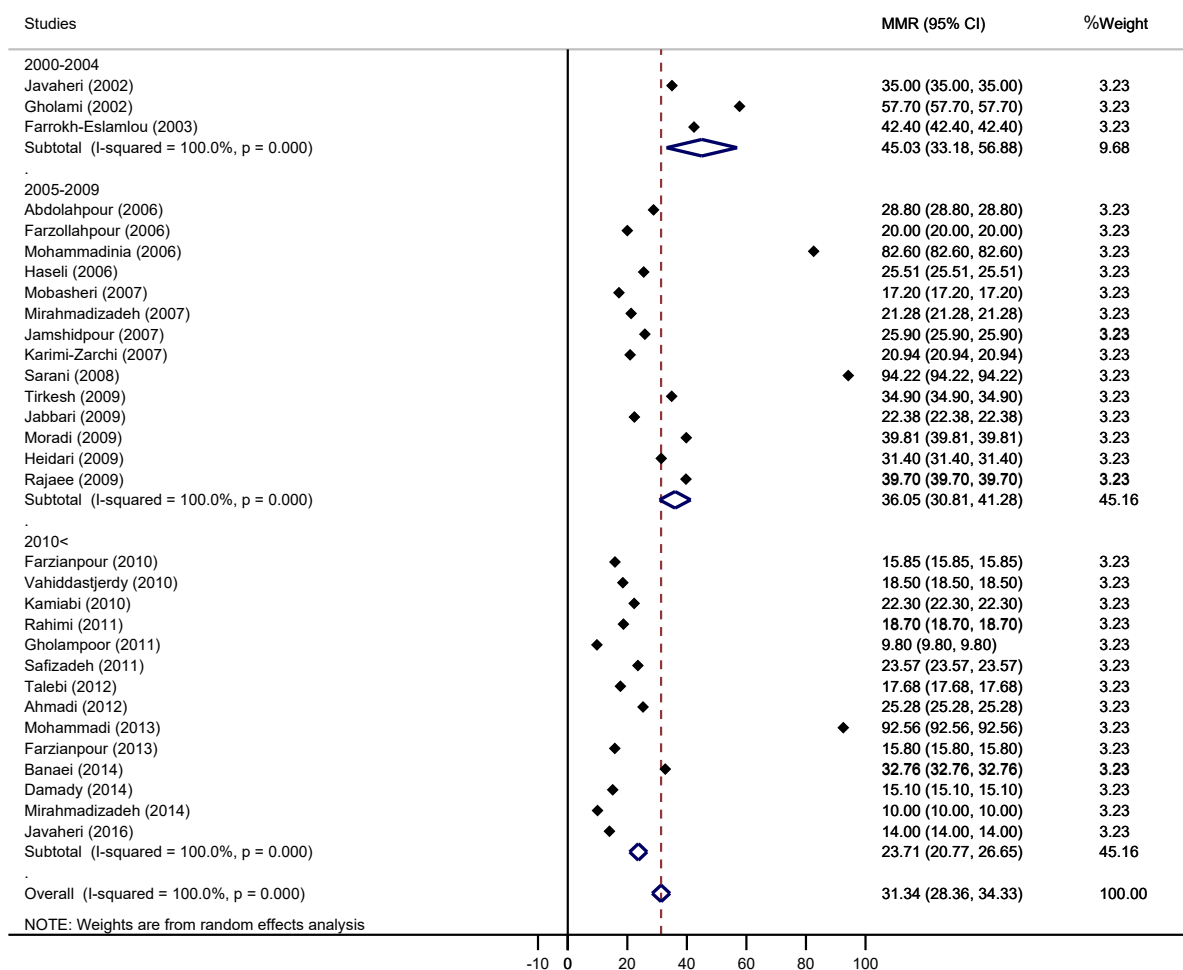
The MMR among live births was reported in 42 studies, ranging from 0 to 248.7 per 100 000 births (95% CI: 36.67–44.16) from 1963 to 2020. Thirty studies were included in the meta-analysis. The pooled MMR was estimated as 31.34 per 100 000 births (95% CI: 28.36–34.33). Heterogeneity testing ( $I^2 = 100\%$ ) revealed significant differences among the included studies in the meta-analysis. Multivariate meta-regression analysis showed that MMR was significantly decreased by almost 5 per 100 000 births with each increase in study year (adjusted  $\beta = -2.097$ ;  $P = 0.046$ ). Therefore, we performed a subgroup analysis according to the study year/median study year. After 2010, the overall pooled MMR was 23.71 (95% CI: 20.77–26.65), and this was estimated at 15.8 per

100 000 births in 2020 based on the adjusted regression coefficient (Figure 2). Sensitivity analysis was not significant for the pooled estimate of MMR (29.25; 95% CI: 26.37–32.12).

### Causes and risk factors for maternal mortality

Common causes of maternal mortality were reported in 35 studies. Obstetric haemorrhage, eclampsia/pre-eclampsia, infection, embolism, delays in treatment, and underlying conditions (e.g. heart disease) were the most common causes of maternal mortality among Iranian pregnant women. Maternal infections, haemorrhage, eclampsia/pre-eclampsia, and underlying diseases (e.g. embolism, cardiac disease, and nervous system disorders) were leading causes of maternal mortality (4,51). The risk factors for maternal mortality were determined in 25 studies. Common significant risk factors were the type of delivery (caesarean section), insufficient antenatal and delivery care, skill of person who performed the delivery, low maternal educational level (illiterate/primary school), low Human Development Index, residence in rural and remote areas, and age.

**Figure 2 Forest plot of pooled maternal mortality ratios. Random-effects model was used to estimate overall pooled rate. I<sup>2</sup> test measured between-study heterogeneity; the horizontal lines indicate 95% confidence intervals. The diamonds indicate pooled rate estimates. Year shows study period/median year of study period.**





## Discussion

This systematic review and meta-analysis estimated MMR among Iranian women and provided an overview of the causes of maternal mortality and its related risk factors. The overall pooled MMR was 31.34 per 100 000 live births, according to studies published in 1970–2021. The heterogeneity in our findings resulted from the year that studies were conducted, and the subgroup analysis showed that after 2010, the estimated pooled MMR was 23.71 per 100 000 live births. The most common causes of maternal mortality were haemorrhage, hypertensive disorders, infection, embolism, delays in treatment, and underlying conditions. Significant risk factors for maternal mortality were type of delivery, insufficient antenatal and delivery care, the person who performed the delivery, low maternal educational level, low Human Development Index, residence in rural and remote areas, and age.

We found that pooled MMR in the Islamic Republic of Iran was lower than the global estimate (211 per 100 000 live births) (40), which was affected by the study year. A previous systematic review showed that, except for developed countries, there was large variability in national maternal mortality estimates (41). Girum et al., in an ecological study in 82 developing countries from 2008 to 2016, found that MMR ranged from 7.0 per 100 000 live births in Cape Verde to 1360 per 100 000 live births in Sierra Leone, with an average of 311 (19). In developed countries, MMR was 17.5 in the United States of America (42), 9.3 in Canada (43), 9.2 in Italy (27), and 5.0 in Japan (44), which are lower than our pooled estimate. However, our subgroup analysis showed that pooled MMR had a decreasing trend and reached 23.71 per 100 000 live births after 2010 and 15.8 in 2020. Recent studies reported that maternal deaths attributed to COVID-19 could have affected our MMR estimation for 2020 and the decreasing MMR trend in the Islamic Republic of Iran (45,46).

The Islamic Republic of Iran has achieved the fifth goal of the United Nations Millennium Development Goals, and MMR has decreased from 48 deaths per 100 000 live births in 2000 to 16 in 2017, showing an annual reduction rate of about 6.3% (23). The Iranian Government and Ministry of Health have taken valuable measures to reduce maternal mortality over the past few decades. The improvement in this indicator was a consequence of women's increased literacy and their enhanced social status, accompanied by expanded availability of facilities in reproductive healthcare, including pregnancy-related care, establishment of mother-friendly hospitals, safe delivery, facilitation of access to free family planning services, and qualitative and quantitative expansion of civil society networks and community health centres (47, 48). The comprehensive family planning programme in the Islamic Republic of Iran since the beginning of the 1990s led to significant reductions in fertility and population growth (49). Along with these changes, the country has achieved a dramatic reduction in MMR that is comparable with that in some developed countries (50).

Continuation and advocacy of policies and programmes that promote improved maternal health and safe motherhood are necessary. Further research is needed to determine maternal mortality in different provinces, cities, and remote areas in the Islamic Republic of Iran.

We reported common causes of maternal mortality in the Islamic Republic of Iran. Our results are similar to those of a previous systematic review in which the leading direct and indirect causes of mortality were identified as haemorrhage, hypertensive disorders, and cardiovascular diseases (4). Bailey et al. identified that hypertensive disorders and haemorrhage were the predominant causes of institutional maternal death in 40 low- and middle-income countries (51). Another systematic review showed that leading causes of maternal mortality among adolescents are similar to those among older women, including hypertensive disorders, haemorrhage, abortion, and sepsis (52). In previous observational studies in the Islamic Republic of Iran, pregnancy-related infections and obstetric haemorrhage were the most common causes of maternal deaths (53–55). Most recent studies stated that the major causes of maternal deaths in the Islamic Republic of Iran showed a shift towards eclampsia/pre-eclampsia and underlying disease (37,56–60). However, Banaei et al. in 2020 (57) and Barzegar et al. in 2019 (58) indicated that pregnancy-related infection was still one of the most common causes of maternal mortality. Despite established interventions to prevent and treat direct causes of maternal deaths, pre-eclampsia and eclampsia are still the major causes of maternal mortality globally (61,62). WHO highlighted that all women need access to high-quality care during pregnancy and during and after childbirth. It is crucial that all births are attended by skilled health professionals, as timely management and treatment can make a difference to the risks for mothers and infants (62). Understanding the context-based causes of maternal deaths and identifying the causes with high priority is critical for policymakers to develop interventions to reduce the burden of mortality and morbidity.

In this systematic review, we evaluated factors related to maternal mortality. Consistent with previous studies (4,63,64), we found that type of delivery, antenatal and delivery care, the person who performed the delivery, maternal educational level, Human Development Index, residence in rural and remote areas, and maternal age had significant effects on maternal mortality. Identification of these factors is challenging because of the variations in study dates, design, and population, and confounder variables. To improve maternal health, barriers that limit access to quality maternal health services must be identified and addressed at both health system and societal levels (62). Further studies are required to understand which specific aspects of maternal health could be improved to reduce maternal deaths in the Islamic Republic of Iran.

Most maternal deaths are preventable and medical comorbidities, pregnancy complications, and

socioeconomic inequalities are important risk factors. The healthcare solutions to prevent or manage maternal complications are well known. According to the particular situation of each country, policymakers and health system managers should develop comprehensive policies and interventions to reduce maternal mortality, particularly for fragile states. Coverage of all pregnancies and childbirths in each region is essential for understanding the underlying causes of maternal mortality. The prevention of unwanted pregnancies is also crucial to avoid maternal deaths. One of the challenges in maternal mortality in the Islamic Republic of Iran is government policies in recent years to promote large families, which may increase maternal mortality. The Ministry of Health can prevent the increase in MMR by providing appropriate health education, advocating family planning, and monitoring a downward trend in MMR.

There were a few limitations to our systematic review. Several included studies did not clearly report the causes and risk factors for maternal mortality, and we could not comprehensively assess these factors and report group-specific MMR. We used the mean and standard error of MMR during the study period and assumed a normal distribution, which may have led to underestimating the right tail of the distribution. Most of the included studies used data from the Maternal Mortality Surveillance System, and/or medical records that were likely incomplete. As a result, the MMR estimate may have been subject to underestimation and uncertainty. These data were not collected primarily for research purposes and often contained noisy, inconsistent, or wrong information. Given the nature of maternal mortality data and the observational design of the included studies, most studies in the review were at risk of bias, and the quality of existing evidence was not ideal. However, our

systematic review provides valuable insight into the maternal mortality in the Islamic Republic of Iran, which could inform public health and public policy decision-makers. Lastly, publication bias was also likely for MMR in some provinces.

## Conclusion

MMR in the Islamic Republic of Iran has undergone a significant overall reduction during the last few decades. MMR was estimated at 15.8 per 100 000 live births in 2020, which shows that the Islamic Republic of Iran has reached the fifth Millennium Development Goal by reducing MMR by almost 75% from 1990 figures. Trained healthcare workers should carefully monitor mothers during pregnancy, delivery, and postpartum, particularly in handling postpartum complications, such as haemorrhage and infections. The identified risk factors and causes of maternal deaths demonstrate the importance of improving the quality of pregnancy care services, universal access to reproductive healthcare, access to skilled birth attendance, and reducing socioeconomic inequalities. Our findings could help increase awareness of decision-makers and policymakers about the magnitude, social effects, and preventability of maternal mortality, which may lead them to target actions for each avoidable factor. We suggest a national study to determine factors related to maternal deaths and identify the provinces that need more attention.

**Funding:** This research was supported by the Elite Researcher Grant Proposal under award No. 963561 from the National Institute for Medical Research Development, Tehran, Islamic Republic of Iran.

**Competing interests:** None declared.

## Analyse systématique et méta-analyse du taux de mortalité maternelle et des facteurs associés en République islamique d'Iran

### Résumé

**Contexte :** La mortalité maternelle est une indication de l'état de santé des femmes dans la société.

**Objectifs :** Étudier le taux de mortalité maternelle, les causes de ce type de mortalité et les facteurs de risque associés chez les femmes iraniennes.

**Méthodes :** À l'aide de la liste de contrôle PRISMA (Éléments de notification préférés à des fins d'examen et de méta-analyses systématiques – Preferred Reporting Items for Systematic Reviews and Meta-Analyses) et de la ligne directrice PRESS (Examen par des pairs des stratégies de recherche électronique – Peer Review of Electronic Search Strategies), nous avons effectué des recherches systématiques dans les bases de données électroniques et dans la littérature grise pour les publications en farsi et en anglais de 1970 à janvier 2022 afin de trouver des études ayant rapporté le nombre de décès maternels et/ou le taux de mortalité maternelle ainsi que leurs facteurs associés. L'analyse des données a été réalisée à l'aide du logiciel Stata 16 et un  $p$  bilatéral inférieur ou égal à 0,05 a été considéré comme statistiquement significatif, sauf indication contraire.

**Résultats :** Une méta-analyse en sous-groupes d'études menées depuis 2000 a estimé le taux de mortalité maternelle à 45,03 pour 100 000 naissances durant la période comprise entre 2000 et 2004, à 36,05 pour celle allant de 2005 à 2009 et à 23,71 après 2010. Les facteurs de risque de mortalité maternelle les plus fréquents étaient les suivants : la césarienne, les soins prénatals et l'accouchement de mauvaise qualité, les accouchements en présence de personnel non qualifié, l'âge, le faible niveau d'éducation des mères, un indice de développement humain inférieur et la résidence dans des zones rurales ou éloignées.

**Conclusion :** Il y a eu une baisse significative de la mortalité maternelle en République islamique d'Iran au cours des dernières décennies. Les mères dans le pays doivent être suivies plus attentivement par des agents de santé formés pendant la grossesse, l'accouchement et la période postpartum afin qu'elles puissent faire face efficacement aux complications survenant durant cette période, telles que les hémorragies et les infections, ce qui permettra de réduire davantage la mortalité maternelle.

## استعراض منهجي وتحليل تلوي لمعدل وفيات الأمهات والعوامل المرتبطة به في جمهورية إيران الإسلامية

ملاهاث خليلي، مهديه مشروطة، علي هخندوست، سمانه تركيان، مريم تشييجيني

### الخلاصة

الخلفية: يُعد معدل وفيات الأمهات مؤشراً على الحالة الصحية للمرأة في المجتمع.

الأهداف: هدفت هذه الدراسة إلى استعراض معدل وأسباب وفيات الأمهات وعوامل الخطر ذات الصلة في أوساط الإيرانية.

طرق البحث: باستخدام القائمة المرجعية للعناصر الموصى بها لإعداد تقارير الاستعراضات المنهجية والتحليلات التلوية (PRISMA) والمبادئ التوجيهية لاستعراض الأقران لاستراتيجيات البحث الإلكتروني (PRESS)، بحثنا بحثاً منهجياً في قواعد البيانات الإلكترونية والمؤلفات غير المعلنة، عن المواد المنشورة باللغتين الفارسية والإنجليزية في المدة من عام 1970 إلى يناير/ كانون الثاني 2022، التي تتضمن دراسات أبلغت عن عدد وفيات الأمهات و/ أو معدل وفيات الأمهات والعوامل ذات الصلة. وحللنا البيانات باستخدام الإصدار 16 من برنامج Stata، واعتُبرت القيمة الاحتمالية المزدوجة  $\geq 0.05$  ذات دلالة إحصائية، ما لم يُحدد خلاف ذلك.

النتائج: قَدَّر التحليل التلوي للمجموعات الفرعية من الدراسات التي أُجريت منذ عام 2000 أن معدل وفيات الأمهات بلغ 45.03 لكل 100000 ولادة خلال المدة 2004-2000، و36.05 خلال المدة 2009-2005، و23.71 بعد عام 2010. وكانت عوامل الخطر الأكثر شيوعاً لوفيات الأمهات تتمثل في العمليات القيصرية، وسوء الرعاية قبل الولادة وأثناءها، وعدم توفر اختصاصي ولادة ماهرة، والعمر، وانخفاض مستوى تعليم الأمهات، وانخفاض مؤشر التنمية البشرية، والإقامة في المناطق الريفية أو النائية.

الاستنتاج: لقد حدث انخفاض كبير في معدل وفيات الأمهات في جمهورية إيران الإسلامية خلال العقود القليلة الماضية. ويتعين رصد أوضاع الأمهات في البلد بمزيد من العناية من خلال عاملين صحيين مدرين أثناء الحمل والولادة وبعد الولادة حتى يتسنى التعامل بفعالية مع مضاعفات ما بعد الولادة، مثل النزيف والعدوى، ومن ثم، زيادة تخفيض معدل وفيات الأمهات.

## References

1. Azuh DE, Azuh AE, Iweala EJ, Adeloye D, Akanbi M, Mordi RC. Factors influencing maternal mortality among rural communities in southwestern Nigeria. *International journal of women's health*. 2017 Apr 10;9:179–88. <https://doi.org/10.2147/IJWH.S120184> PMID:28442936
2. The Global Health Observatory. Explore a world of health data. Maternal deaths [website]. Geneva: World Health Organization; 2021 (<https://www.who.int/data/gho/indicator-metadata-registry/imr-details/4622>, accessed 10 April 2023).
3. Rajae M, Zare S, Dadipour S, Fallahi S, Rajae F, Mobarakabadi A, et al. Determining the frequency and causes of maternal mortality in hormozgan province, Iran during 2005–2011. *Iran J Obstet Gynecol Infert*. 2014;16(87):9–14 (in Persian). [http://ijogi.mums.ac.ir/article\\_2432.html](http://ijogi.mums.ac.ir/article_2432.html)
4. Zalvand R, Tajvar M, Pourreza A, Asheghi H. Determinants and causes of maternal mortality in Iran based on ICD-MM: a systematic review. *Reprod Health*. 2019;16:16. <https://doi.org/10.1186/s12978-019-0676-y>
5. International Statistical Classification of Diseases and Related Health Problems: 10th revision. Geneva: World Health Organization; 2007 (<http://apps.who.int/classifications/apps/icd/icd10online/>, accessed 10 April 2023).
6. Isogai T, Kamiya CA. Worldwide incidence of peripartum cardiomyopathy and overall maternal mortality. *Int Heart J*. 2019 May 30;60(3):503–11. DOI: 10.1536/ihj.18-729 PMID: 31019181
7. Jenabi E, Khazaei S. Maternal mortality ratio in Iran compared to other regions (1990–2015): progress and challenges. *J Matern Fetal Neonat Med*. 2019 Apr;32(8):1398–400. DOI: 10.1080/14767058.2017.1406471 PMID: 29141469
8. Saadati N, Moramezi F, Cheraghi M, Sokhray L. Using celecoxib for the suppression of preterm labor instead of magnesium sulfate. *J Pregnancy*. 2014;2014: 869698. DOI: 10.1155/2014/869698 PMID: 25400947
9. Emamifshar N, Jalilvand P, Delavar B, Radpouyan L, Azemikah A, Valafar S. National maternal surveillance system. Tehran: Tandis Publication; 2006.
10. King JC. Maternal mortality in the United States - why is it important and what are we doing about it? *Semin Perinatol*. 2012 Feb;36(1):14–8. DOI: 10.1053/j.semperi.2011.09.004 PMID: 22280860

11. Maria C, Zahra R, Sara P. Prevalence of cervical–vaginal infections in the pap-smear samples in Iran. *Glob J Health Sci*. 2013 Dec 19;6(1):201. DOI: 10.5539/gjhs.v6n1p201 PMID: 24373280
12. Cheraghi M, Najafian M, Amoori N, Bazargan A, Cheraghi M. Risk factors of postpartum depression in Ramhormoz city, Iran. *Neuropsychiatry Neuropsychol*. 2015;10(1):1–4. <https://www.termedia.pl/Original-article-Risk-factors-of-postpartum-depression-in-Ramhormoz-city-Iran-,46,25393,1,1.html>
13. Sustainable Development Goals 2015 [website]. United Nations; 2015 (<https://www.un.org/sustainabledevelopment/sustainable-development-goals/>, accessed 10 April 2023).
14. Stronger collaboration for an equitable and resilient recovery towards the health-related Sustainable Development Goals. Geneva: World Health Organization. 2021 (<https://www.who.int/publications/i/item/9789240026209>, accessed 10 April 2023).
15. Douthard RA, Martin IK, Chapple-McGruder T, Langer A, Chang S. U.S. maternal mortality within a global context: historical trends, current state, and future directions. *J Womens Health*. 2021 Feb;30(2):168–77. DOI: 10.1089/jwh.2020.8863 PMID: 33211590
16. Maternal deaths decline slowly with vast inequalities worldwide. Geneva: World Health Organization; 2019 (<https://www.who.int/news/item/19-09-2019-maternal-deaths-decline-slowly-with-vast-inequalities-worldwide>, accessed 10 April 2023).
17. Alkema L, Chou D, Hogan D, Zhang S, Moller A-B, Gemmill A, et al. Global, regional, and national levels and trends in maternal mortality between 1990 and 2015, with scenario-based projections to 2030: a systematic analysis by the UN Maternal Mortality Estimation Inter-Agency Group. *Lancet*. 2016;387(10017):462–74. DOI: 10.1016/S0140-6736(15)00838-7 PMID: 26584737
18. Trends in maternal mortality: 1990 to 2013: estimates by WHO, UNICEF, UNFPA, The World Bank and the United Nations Population Division. Geneva: World Health Organization; 2014 ([https://apps.who.int/iris/bitstream/handle/10665/112682/9789241507226\\_eng.pdf;jsessionid=E3EF2B7AAC91D33EE1B07D2F93DF51F3?sequence=2](https://apps.who.int/iris/bitstream/handle/10665/112682/9789241507226_eng.pdf;jsessionid=E3EF2B7AAC91D33EE1B07D2F93DF51F3?sequence=2), accessed 10 April 2023).
19. Girum T, Wasie A. Correlates of maternal mortality in developing countries: an ecological study in 82 countries. *Matern Health Neonatol Perinatol*. 2017 Nov 7;3:19. DOI: 10.1186/s40748-017-0059-8 PMID: 29142757
20. World Bank Data Team. Over 99 percent of maternal deaths occur in developing countries [website]. World Bank; 2012 (<https://blogs.worldbank.org/opendata/over-99-percent-maternal-deaths-occur-developing-countries>, accessed 10 April 2023).
21. About the UN in Iran [website]. Tehran: United Nations I.R. Iran; 2021 (<https://iran.un.org/en/about/about-the-un>, accessed 10 April 2023).
22. Population and housing censuses [website]. Tehran: Statistical Centre of Iran (<https://www.amar.org.ir/english/Population-and-Housing-Censuses>, accessed 10 April 2023).
23. Mirghafourvand M, Khosravi S, Tabrizi JS, Mohammadi A, Abedi P. Two decades of Iranian midwives' activities as a health care provider under supervision in a multidisciplinary team in reducing maternal mortality. *Reprod Health*. 2021;18(1):37. <https://doi.org/10.1186/s12978-021-01100-3>
24. Zarei E, Khosravi A, Motlagh ME, Emami Afshar N, Rahimi A, Torkestani F, et al. Maternal mortality in Iran: realization of the Millennium Development Goals. *J Mazandaran Univ Med Sci*. 2017;27(149):192–6. <http://jmmums.mazums.ac.ir/article-1-8950-en.html>
25. World Health Organization. Maternal mortality in 2000–2017. Internationally comparable MMR estimates by the Maternal Mortality Estimation Inter-Agency Group (MMEIG), IRAN (ISLAMIC REPUBLIC OF). Geneva: World Health Organization; 2015 ([https://cdn.who.int/media/docs/default-source/gho-documents/maternal-health-countries/maternal\\_health\\_irn\\_en.pdf](https://cdn.who.int/media/docs/default-source/gho-documents/maternal-health-countries/maternal_health_irn_en.pdf), accessed 10 April 2023).
26. Sharifi H, Changizi N, Hejazi S, Afshar N, Rahimi S, Haghdoost AA, et al. Status and trend of maternal mortality in Iran (2016–2018). Tehran: Maternal Health Department, Population, Family and School Health Office, Deputy of Health, Ministry of Health; 2019.
27. Donati S, Maraschini A, Lega I, D'Aloja P, Buoncristiano M, Manno V, et al. Maternal mortality in Italy: results and perspectives of record-linkage analysis. *Acta Obstet Gynecol Scand*. 2018 Nov;97(11):1317–24. DOI: 10.1111/aogs.13415 PMID: 29956300
28. Edler C, Spermhake JP, Püschel K, Schröder AS. Pregnancy-related and maternal deaths in Hamburg, Germany: an autopsy study from 1984–2018. *Forensic Sci Med Pathol*. 2019 Dec;15(4):536–41. DOI: 10.1007/s12024-019-00138-x PMID: 31372923
29. Haque R, Bhuiyan SU, Rudra R. A review of maternal and child health status in Canada and Japan – reinvigorating maternal and child health handbook. *J Commun Prev Med*. 2019;2(1):1–9. <https://asclepiusopen.com/journal-of-community-and-preventive-medicine/volume-2-issue-1/5.pdf>
30. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Ann Intern Med*. 2009 Jul 21;151(4):264–9. DOI: 10.1371/journal.pmed.1000097 PMID: 19621072
31. McGowan J, Sampson M, Salzwedel DM, Cogo E, Foerster V, Lefebvre C. PRESS Peer Review of Electronic Search Strategies: 2015 guideline statement. *J Clin Epidemiol*. 2016 Jul;75:40–6. DOI: 10.1016/j.jclinepi.2016.01.021 PMID: 27005575
32. JBI's critical appraisal tools assist in assessing the trustworthiness, relevance and results of published papers [website]. Joanna Briggs Institute; 2020 (<https://jbi.global/critical-appraisal-tools>, accessed 10 April 2023).
33. Karamouzian M, Nasirian M, Ghaffari Hoseini S, Mirzazadeh A. HIV and other sexually transmitted infections among female sex workers in Iran: a systematic review and meta-analysis. *Arch Sex Behav*. 2020 Aug;49(6):1923–37. DOI: 10.1007/s10508-019-01574-0 PMID: 31701288



34. Xu Y, Chen X, Wang K. Global prevalence of hypertension among people living with HIV: a systematic review and meta-analysis. *J Am Soc Hypertens*. 2017 Aug;11(8):530–40. DOI: 10.1016/j.jash.2017.06.004 PMID: 28689734
35. Deeks JJ, Higgins JP, Altman DG. Analysing data and undertaking meta-analyses. In: Higgins JPT, S G, editors. *Cochrane handbook for systematic reviews of interventions*. The Cochrane Collaboration; 2011:9.1–9.44.
36. Hashemi SN, Afshari P, Javadnoori M, Malehi AS. Prevalence and related factors of maternal severe complications “maternal near miss” in ahvaz, 2016. *Iran J Obstet Gynecol Infertil*. 2020 Apr;23(2):78–87. <https://doi.org/10.22038/IJOGI.2020.15966>
37. Tajvar M, Yaseri M, Mosadeghrad A, Zalvand R. Trends in the causes of maternal mortality in Iran and other countries in the region during the years 1990 – 2016. *J Babol Univ Med Sci*. 2019;21(1):390–7. <http://jbums.org/article-1-8339-en.html>
38. Emami NH, Zarkesh M, Milani F. Maternal and neonatal complications in the pregnant women aged less than 20 years. *Iran J Neonatol*. 2018 Jun;9(2):71–2. DOI: 10.22038/ijn.2018.25629.1338
39. Zokaei M, Homayonpoo G, Ghaderi E, Zandvakili F, Salahian B, Mafakheri F. Investigation and comparison of the factors associated with maternal death between verbal autopsy and forensic autopsy from 2001 to 2013 in Kurdistan province. *Sci J Kurdistan Univ Med Sci*. 2015;20(1):18–29 (in Persian). <http://sjku.muk.ac.ir/article-1-1697-en.html>
40. WHO UNICEF, UNFPA, World Bank Group, and the United Nations Population Division. Trends in maternal mortality: 2000 to 2017 [website]. Geneva: World Health Organization; 2019 ([https://data.worldbank.org/indicator/SH.STA.MMRT?year\\_high\\_desc=false](https://data.worldbank.org/indicator/SH.STA.MMRT?year_high_desc=false), accessed 10 April 2023).
41. Betrán AP, Wojdyla D, Posner SF, Gülmezoglu AM. National estimates for maternal mortality: an analysis based on the WHO systematic review of maternal mortality and morbidity. *BMC Public Health*. 2005 Dec 12;5(1):131. DOI: 10.1186/1471-2458-5-131 PMID: 16343339
42. Hoyert DL, Miniño AM. Maternal Mortality in the United States: changes in coding, publication, and data release, 2018. *Nat Vital Stat Rep*. 2020 Jan;69(2):1–18. PMID: 32510319
43. Ray JG, Park AL, Dzakpasu S, Dayan N, Deb-Rinker P, Luo W, et al. Prevalence of severe maternal morbidity and factors associated with maternal mortality in Ontario, Canada. *JAMA Netw Open*. 2018 Nov 2;1(7):e184571-e. DOI: 10.1001/jamanetworkopen.2018.4571 PMID: 30646359
44. WHO UNICEF, UNFPA, World Bank Group, and the United Nations Population Division. Maternal mortality ratio (modeled estimate, per 100,000 live births) – Japan [website]. Geneva: World Health Organization; 2019 (<https://data.worldbank.org/indicator/SH.STA.MMRT?locations=JP>, accessed 10 April 2023).
45. Hantoushzadeh S, Shamshirsaz AA, Aleyasin A, Seferovic MD, Aski SK, Arian SE, et al. Maternal death due to COVID-19. *Am J Obstet Gynecol*. 2020 Jul;223(1):109.e1–16. DOI: 10.1016/j.ajog.2020.04.030 PMID: 32360108
46. zahra M, Seyed Mehdi T, Sedighe Share M, Maryam Z. Study factors involved in maternal deaths attributed to COVID-19 in a disadvantaged area in Southeast of Iran. *J Fam Reprod Health*. 2022 Mar;16(1):67–77. DOI: 10.18502/jfrh.v16i1.8596 PMID: 35903768
47. Vakilian K, Khadijeh Mirzaei N. Reproductive health in iran: international conference on population and development goals. *Oman Med J*. 2011 Mar;26(2):143. DOI: 10.5001/omj.2011.36 PMID: 22043404
48. The Vice Presidency for Women & Family Affairs. National review on women’s status in the Islamic Republic of Iran (Beijing+20). [https://sustainabledevelopment.un.org/content/documents/13097Islamic\\_Republic\\_of\\_Iran\\_review\\_Beijing20.pdf](https://sustainabledevelopment.un.org/content/documents/13097Islamic_Republic_of_Iran_review_Beijing20.pdf)
49. Karamouzian M, Sharifi H, Haghdoost AA. Iran’s shift in family planning policies: concerns and challenges. *Int J Health Policy Manag*. 2014 Sep 2;3(5):231–3. DOI: 10.15171/ijhpm.2014.81 PMID: 25337596
50. Moazzeni MS. Maternal mortality in the Islamic Republic of Iran: on track and in transition. *Matern Child Health J*. 2013 May;17(4):577–80. DOI: 10.1007/s10995-012-1043-6 PMID: 22618490
51. Bailey PE, Andualem W, Brun M, Freedman L, Gbangbade S, Kante M, et al. Institutional maternal and perinatal deaths: a review of 40 low and middle income countries. *BMC Pregnancy Childbirth*. 2017 Sep 7;17(1):295. DOI: 10.1186/s12884-017-1479-1 PMID: 28882128
52. Neal S, Mahendra S, Bose K, Camacho AV, Mathai M, Nove A, et al. The causes of maternal mortality in adolescents in low and middle income countries: a systematic review of the literature. *BMC Pregnancy Childbirth*. 2016 Nov 11;16(1):352. DOI: 10.1186/s12884-016-1120-8 PMID: 27836005
53. Daneshbod K, Borazjani GR, Sajadi H, Hamidzadeh MM. Survey of maternal deaths in Sotuth Iran. Analysis of 96 autopsies. *J Obstet Gynaecol Br Commonw*. 1970 Dec;77(12):1103–8. DOI: 10.1111/j.1471-0528.1970.tb03471.x PMID: 4321867
54. Borazjani G, Javey H, Sadjadi HE, Daneshbod K. Maternal mortality in South Iran: a seven-year survey. *Int J Gynecol Obstet*. 1978;16(1):65–9. DOI: 10.1002/j.1879-3479.1978.tb00397.x PMID: 32095
55. Akhlaghi F, Hamed A, Lotfi N. Study of the maternal mortality rate in the last decade in Mashad Emamreza Hospital. *J Sabzevar Univ Med Sci*. 2003;9(4):74–80.
56. Farzollahpour F, Imani R. Evaluation factors affecting the maternal mortality among pregnant women during 2001–2011 in Ardabil Province, Iran. *Med Res J*. 2019;4(2):89–94. DOI: 10.5603/MRJ.a2019.0022
57. Banaei M, Shahrahmani N, Shahrahmani H, Rouzbeh N, Moradi S, Mobarak Abadi A. Prevalence and causes of maternal mortality during the years 2011–2017 in Hormozgan province. *J Prev Med*. 2020;7(1):52–44. <http://jpm.hums.ac.ir/article-1-399-en.html>
58. Barzegar A, Hedayatshodeh M, Forouzes M, Ghadipasha M, Shojaei P, Fallah F. Causes of maternal mortality in Tehran, Iran. *Int J Med Toxicol Forensic Med*. 2019;9(4):283–7. <https://doi.org/10.32598/ijmtfm.v9i4.26647>

59. Mirahmadizadeh A, Semati A, Eshrati B, Moradi F, Asadi N. Root-cause analysis of maternal mortality in fars province, southern iran 2014: negligence is the prime suspect. *J Fam Reprod Health.* 2020 Sep;14(3):166–72. DOI: 10.18502/jfrh.v14i3.4669 PMID: 33603808
60. Javaheri M, Mohammadi Y. Trends and causes of maternal mortality in west of Iran from 2002 to 2016: implications for sustainable development goals. *J S Asian Fed Obstet Gynaecol.* 2020;12(3):159-62. <https://www.jsafog.com/doi/JSAFOG/pdf/10.5005/jp-journals-10006-1785>
61. Filippi V, Chou D, Ronsmans C, Graham W, Say L. Levels and causes of maternal mortality and morbidity. In: *Reproductive, maternal, newborn, and child health: disease control priorities, third edition (volume 2)*. Washington: The International Bank for Reconstruction and Development/World Bank; 2016:51–70.
62. Maternal mortality [website]. Geneva: World Health Organization; 2019 ([https://www.who.int/news-room/fact-sheets/detail/maternal-mortality#:~:text=The%20major%20complications%20that%20account,\(pre%2Declampsia%20and%20eclampsia\)&text=The%20major%20complications%20that%20account,\(pre%2Declampsia%20and%20eclampsia](https://www.who.int/news-room/fact-sheets/detail/maternal-mortality#:~:text=The%20major%20complications%20that%20account,(pre%2Declampsia%20and%20eclampsia)&text=The%20major%20complications%20that%20account,(pre%2Declampsia%20and%20eclampsia), accessed 10 April 2023).
63. Nair M, Knight M, Kurinczuk J. Risk factors and newborn outcomes associated with maternal deaths in the UK from 2009 to 2013: a national case-control study. *BJOG.* 2016 Sep;123(10):1654–62. DOI: 10.1111/1471-0528.13978 PMID: 26969482
64. Bauserman M, Lokangaka A, Thorsten V, Tshetu A, Goudar SS, Esamai F, et al. Risk factors for maternal death and trends in maternal mortality in low- and middle-income countries: a prospective longitudinal cohort analysis. *Reprod Health.* 2015;12 Suppl 2:S5. DOI: 10.1186/1742-4755-12-S2-S5 PMID: 26062992