BMJ Open

The global contribution of suicide to maternal mortality: a systematic review protocol

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2024-087669
Article Type:	Protocol
Date Submitted by the Author:	16-Apr-2024
Complete List of Authors:	Simmons, Emma; University of Oxford, Medical Sciences Division Gong, Jenny; University of Oxford, National Perinatal Epidemiology Unit, Nuffield Department of Population Health Quigley, Maria; University of Oxford, National Perinatal Epidemiology Unit, Nuffield Department of Population Health Alderdice, Fiona; University of Oxford, National Perinatal Epidemiology Unit, Nuffield Department of Population Health; Queen's University Belfast, School of Nursing and Midwifery Harrison, Sian; University of Oxford, National Perinatal Epidemiology Unit, Nuffield Department of Population Health Fellmeth, Gracia; University of Oxford, National Perinatal Epidemiology Unit, Nuffield Department of Population Health
Keywords:	Systematic Review, Suicide & self-harm < PSYCHIATRY, Maternal medicine < OBSTETRICS

Title: The global contribution of suicide to maternal mortality: a systematic review protocol

Authors
Emma Simmons[1], Jenny Gong[2], Maria Quigley[2], Fiona Alderdice[2,3], Siân Harrison[2], Gracia Fellmeth[2]

Affiliations
1. Medical Sciences Division, University of Oxford, Oxford, UK
2. National Perinatal Epidemiology Unit, Nuffield Department of Population Health, University of Oxford, Oxford, UK
3. School of Nursing and Midwifery, Queen's University Belfast, Belfast, UK

Contact emails
emma.simmons@pmb.ox.ac.uk
jenny.gong@ndph.ox.ac.uk
maria.quigley@npeu.ox.ac.uk
fiona.alderdice@npeu.ox.ac.uk
sian.harrison@npeu.ox.ac.uk
gracia.fellmeth@ndph.ox.ac.uk

Corresponding author
Gracia Fellmeth
National Perinatal Epidemiology Unit (NPEU)
Nuffield Department of Population Health
University of Oxford
Old Road Campus
Roosevelt Drive
Oxford OX3 7LF
United Kingdom
Tel. 01865 289745
Email: gracia.fellmeth@ndph.ox.ac.uk

Keywords
Suicide; maternal; perinatal; systematic review; global

Word count
2592

TITLE: The global contribution of suicide to maternal mortality: a systematic review protocol

ABSTRACT

Introduction: Maternal suicide is a significant contributor to maternal mortality with devastating consequences for women, families and society. Maternal mortality reporting systems differ across countries and there is no up-to-date overview of maternal suicide deaths globally. This systematic review aims to synthesise the evidence on maternal suicide. The primary objective is to determine the contribution of suicide towards maternal mortality globally and explore differences between geographical regions. The secondary objectives are to summarise the availability and quality of data globally and to describe how suicide deaths are classified across different countries.

Methods and analysis: This protocol follows the Preferred Reporting Items for Systematic Reviews and Meta-analyses for systematic review protocols (PRISMA-P) guidelines. Medline, Embase, PsychINFO, Global Health and CINAHL databases and the grey literature were searched with no date or language restrictions. Observational studies, national surveys and reports that present data on maternal deaths due to suicide occurring during pregnancy, intrapartum and in the post-partum period will be included. Screening, data extraction and quality assessment will be conducted independently by two reviewers. Results will be summarised narratively. If sufficient outcome data is available, random-effects meta-analyses will be conducted to determine global pooled estimates of suicide-related maternal mortality rates and the proportion of maternal deaths attributable to suicide.

Ethics and dissemination: Ethical approval is not required for this systematic review. Results will be written up for publication in a peer-reviewed journal and findings will be shared at national and international conferences.

Prospero registration number: CRD42023429072

ARTICLE SUMMARY

Strengths and limitations of this study

- This will be the first systematic review of the contribution of suicide to maternal deaths globally.
- We will follow rigorous methods and report our methodology and results in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines.
- The search strategy is highly comprehensive and was developed with an experienced university librarian.
- We will conduct the search without language or date limitations, allowing us to include non-English publications which are often omitted in systematic reviews.
- We will conduct an extensive grey literature search to identify non-indexed and non-academic publications including maternal mortality databases and surveillance reports.
- A limitation of our review is that we will exclude maternal deaths due to injury or accidents.

INTRODUCTION

Rationale

Maternal suicide, defined as death by suicide occurring during pregnancy or within one year of giving birth, is a significant contributor to maternal mortality with devastating consequences for women, families and society. Across a number of high-income countries including the United Kingdom and the USA, suicide is one of the leading causes of maternal death.[1,2] In the UK, the most recent data suggests that between 2019-2021 almost 40% of maternal deaths between six weeks and twelve months after childbirth were due to suicide.[1] In lower-resource settings, where rates of all-cause maternal mortality are often higher overall, the contribution of suicide to maternal deaths is less clear. A previous review reported a maternal suicide prevalence of 1% across low- and middle-income countries (LMIC) with a wide range in prevalence between regions.[3]

Understanding the magnitude of suicide-related maternal mortality is important to improve assessment, identification and reporting of maternal suicide deaths and inform prevention strategies. However, there are a number of challenges in accurately estimating the burden. Firstly, there are a number of different definitions of maternal death (**Figure 1**). The World Health Organization (WHO) uses the terms *maternal death* and *late maternal death*, which are defined in the International Classification of Diseases (11th Revision; ICD-11) and which differ from each other only in terms of the time periods they cover.[4,5] Maternal deaths and late maternal deaths are combined in the ICD-11 under a new grouping of *comprehensive maternal deaths*.[4] Others, notably the US Centres for Disease Control and Prevention (CDC), refer to *pregnancy-associated* and *pregnancy-related deaths*, which both span the same time period but differ according to the designated cause of death.[6] Confusingly, the WHO also refers to *pregnancy-related death*, but defines this term differently from the CDC both in terms of the causes included and the time period covered.[5] In reports and publications presenting maternal death statistics, there is often a lack of clarity around which definition was applied.

Figure 1. Definitions of maternal death
[INSERT Figure 1 here]

Secondly, there are differences in the denominator used to calculate rates of maternal mortality. The commonly reported maternal mortality ratio (MMR) reports the number of maternal deaths during a given time period per 100,000 live births during the same time period.[5] The use of live births as a denominator means that deaths occurring during pregnancy and stillbirths are not captured by the MMR. To address this, some countries such as the UK also report the number of maternal deaths per 100,000 maternities, defined as the number of women giving birth, including stillbirth, at or beyond 24 weeks' gestation.[1] When maternities are used as the denominator, the statistic is often referred to as a maternal mortality *rate* (rather than ratio), but the terminology is inconsistent and in practice the distinction between MMR and maternal mortality rates is often unclear. These differences create challenges when comparing statistics between countries or across different reporting systems.

Thirdly, there is variation in the availability and quality across different regions of the world. High quality data on maternal suicide requires an accurate identification of all maternal deaths, as well as an accurate designation of cause of death. Some countries have systems in place to identify and investigate maternal deaths and their causes at a regional or national level. Such systems include systematic maternal mortality surveillance systems, confidential enquiries and Reproductive Age Mortality Surveys (RAMOS). The assignation of cause of death can include the use of formal death registration certificates and verbal autopsies in which family members are asked to provide information on circumstances around the death. In countries with less robust death reporting systems it is difficult to determine how accurate maternal death reporting is.

A final challenge is the misclassification of deaths by suicide to other causes such as injury or accidents. This is thought to be common given the stigma associated with suicide and its criminalisation in some societies.[3] A review of maternal suicide in LMIC found that reclassifying the leading suicide methods from injuries to suicide increased the pooled prevalence of pregnancy-related suicide deaths from 1.00 to 1.68.[3] Misclassification is compounded by the fact that until the most recent revision of the ICD, maternal suicide did not have a specific code. There has also been a change in the recommended classification of maternal suicides. The ICD-10 categorised maternal deaths due to injuries or mental disorders as indirect maternal deaths.[7] The WHO subsequently published a derivation of the ICD-10: this ICD-Maternal Mortality (ICD-MM) calls for maternal suicides to be classified as direct maternal deaths.[8] This discrepancy has led to variations in the reporting of maternal suicide as direct or indirect causes of death, with some statistics reporting maternal suicide as an incidental cause of death and other statistics excluding suicides from their maternal mortality data altogether.[9]

There are several existing systematic reviews of maternal suicide but these are limited to specific perinatal populations or geographical regions, and there is no up-to-date synthesis of the global evidence for all perinatal women. Lindahl *et al*. (2005) reviewed prevalence of suicide ideation, attempts and deaths in pregnancy and the post-partum period globally; however this included studies published up to 2002 and their findings need updating.[10] Fuhr *et al*. (2014) assessed the contribution of suicide and injuries to perinatal mortality in LMIC only.[3] Amiri *et al*. (2021) assessed rates of suicide ideation, attempts and mortality globally among post-partum women only.[11] Chin *et al*. (2022) reviewed prevalence, risk factors, outcomes and interventions for perinatal deaths by suicide but focused on a limited number of studies that were not included in an earlier review by Mangla *et al*. (2019).[2] Chin *et al*. (2022) also restricted their search to studies published in English, and most of the identified studies were conducted in the USA.[2]

Our systematic review expands upon previous reviews by including suicides occurring during pregnancy and the post-partum period in all countries globally with no language or date restrictions. Results will enable an estimation of the contribution of suicide to maternal deaths globally and a comparison of the burden across geographical regions. Identifying countries reporting either very high or very low rates will inform further work to determine whether differences in rates reflect true differences or reporting- or coding-related factors. Our review will also show whether maternal suicide deaths are reported as direct, indirect or incidental maternal deaths, informing a possible need for further clarification of the ICD-

11 and ICD-MM classifications. Finally, our review will identify countries for which no data on maternal suicide is available, an important requirement in meeting the United Nations' Sustainable Development Goal (SDG) 3.[12]

Objectives

This systematic review aims to identify and synthesise evidence on maternal suicide deaths globally. The primary objective is to determine the contribution of suicide towards maternal mortality and explore differences between geographical regions. The secondary objectives are to summarise the availability and quality of data globally and to describe how suicide deaths are classified across different countries.

METHODS AND ANALYSIS

Registration and protocol adherence

This systematic review protocol is reported in adherence with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for systematic review protocols (PRISMA-P) guidelines (**Supplementary Information S1**).[13] The review was registered on PROSPERO (CRD42023429072) on 25 May 2023. If important amendments to the protocol are required during the course of the review, these will be recorded as amendments on PROSPERO and reported in the final publication as a deviation from the protocol.

Definitions

For the purposes of this review, we define maternal suicide as the death of a woman by suicide at any time during pregnancy, intrapartum or within one year of giving birth. The perinatal period is the period of pregnancy and up to one year after giving birth.

Eligibility criteria

Population, intervention, comparison and outcome framework
The population of interest is women at any stage of pregnancy or within one year of giving birth. The outcome of interest is death by suicide during the perinatal period. There is no intervention or control for this systematic review of global maternal suicide rates.

Inclusion and exclusion criteria
We will include any study that reports data on the number of maternal deaths due to suicide along with appropriate denominator data (either total live births or total maternities during the same time period as maternal deaths). Studies reporting the proportion of all maternal deaths that were due to suicide will also be included. We will include cohort, cross-sectional and case control study designs as well as data from national surveys, databases and reports such as mortality statistics and confidential enquiries. Qualitative studies will be excluded as they are unlikely to contain numerator and denominator data on maternal suicide and maternal death. There will be no minimum threshold applied to the sample size or numbers of suicides reported. Studies that do not report data on the denominator to allow calculation of the MMR attributable to suicide or the proportion of

deaths that are due to suicide will be excluded. Studies in which suicide deaths cannot be differentiated from deaths from injury or other causes will also be excluded. We will include studies published in any language.

Patient and public involvement

There was no patient or public involvement in the design of this systematic review.

Search strategy and data sources

Medline, Embase, PsychINFO, Global Health and CINAHL databases were searched with no date or language restrictions on 5 May 2023. A search strategy using terms relevant to perinatal status, mortality and suicide was developed in collaboration with a university research librarian and adapted for each database. The search strategy used for Medline is shown in **Table 1**. In order to capture relevant evidence not published in the databases above, we conducted an extensive grey literature search. This involved searches of *Google* and *Google Scholar* using the relevant terms listed above to capture non-academic articles such as reports and statistical databases. We also searched the websites of the World Health Organization (WHO), the United Nations Children's Fund (UNICEF), the United Nations Population Fund (UNFPA), UN Women, the World Bank and the Global Burden of Disease Study to identify relevant reports. All records identified by the database search and grey literature searches were combined and duplicates removed using *Endnote*.[14] De-duplicated references were imported into *Covidence* for screening, data extraction and quality assessment.[15]

Table 1. Search strategy for Medline

1	Pregnancy/ or Pregnant Women/
2	Postnatal Care/ or Postpartum Period/
3	1 or 2
4	Mortality/
5	3 and 4
6	maternal mortality/ or maternal death/
7	((pregnan* or maternal or postnatal or post-natal or postpart* or post-part*) and (death? or mortality or fatalit*)).ti.
8	((pregnan* or maternal or postnatal or post-natal or postpart* or post-part*) adj3 (death? or mortality or fatalit*)).ti,ab,kf.
9	5 or 6 or 7 or 8
10	"cause of death"/
11	Death Certificates/
12	exp suicide/
13	"cause of death".ti,ab,kf.
14	(suicid* or overdos* or self harm or self injury or violen*).ti,ab,kf.
15	10 or 11 or 12 or 13 or 14
16	9 and 15

Data extraction

Screening of titles and abstracts was performed independently by two reviewers (ES and JG) to exclude studies which did not meet inclusion criteria. Any disagreements were discussed and resolved with a third reviewer (SH and GF). Full-texts were retrieved. Any missing full texts were searched for using a university library database, online journal archives, *Google* and by contacting study authors. Any full-texts that could not be retrieved after this search process were excluded. Full-texts of remaining studies were screened independently by two reviewers (ES, JG, SH, GF) and any disagreements were resolved through discussion. Reasons for excluding full-texts were recorded. Two reviewers (ES, JG, SH, GF) will independently extract data from included studies using a standardised and piloted data extraction form consisting of the following fields:

- **Publication details:** lead author, publication year, publication language
- **Setting:** country, region, type of setting (e.g. hospital or community deaths), dates covered, whether data was collected at national or regional level
- **Participants:** perinatal status (pregnant or post-partum), definition of maternal death used, age, any sociodemographic characteristics (e.g. socioeconomic background, ethnicity, income, parity)
- **Methods of assessment:** method of identifying maternal deaths, method of ascertaining cause of death, classification of suicide (as indirect, direct or incidental cause of death)
- **Outcomes:** total maternal deaths, total live births, total maternities, number of suicide deaths, proportion of deaths due to suicide, accuracy measures (e.g. standard deviation, p-values or 95% confidence intervals), mode of suicide

If reported data is unclear or insufficient, authors of the study will be contacted to request the additional data required for inclusion in the review.

Quality assessment and risk of bias

Two reviewers (ES, JG, SH, GF) will independently assess the quality of each included study. We will use criteria adapted from a study by Grollman and Ronsmans[12] to assess quality and risk of bias. This will include assessment of three domains: quality of the method of death ascertainment; completeness of the cause of death assignation; and quality of the method of assigning cause of death. Each study will be assigned a rating of low, medium or high quality in each of these categories using the attributes outlined by Grollman and Ronsmans.[16] Fuhr *et al*. (2014) used an adapted version of these criteria, with only two categories: quality of the method of death ascertainment and completeness of the cause of death assignation.[3] We have chosen this method as there is a precedent for its use in a similar review, and other risk of bias assessment tools have limited application to studies looking at causes of death. Any disagreements will be discussed with the other review authors (FA, MQ) until a consensus is reached.

Data synthesis

A narrative synthesis of included studies will be conducted and a table of study characteristics will be compiled to provide an overview of all included studies. Countries for which data on maternal suicide deaths is available will be mapped and colour-coded

(red/amber/green) according to the quality of evidence. The proportion of countries classifying maternal suicide deaths as direct, indirect or incidental deaths will also be reported. If sufficient data is available, random-effects meta-analyses will be conducted to generate pooled estimates of suicide-related maternal mortality rates. Depending on the data identified and comparability between studies, we will use either live births or maternities as the denominator or conduct a separate pooled estimate for each. Forest plots will be used to present data visually. Statistical heterogeneity between studies will be calculated using the I^2 statistic. If data allows and sufficient studies are identified, we will carry out subgroup analyses to explore differences in suicide death rates according to perinatal status (pregnancy vs. post-partum); country income classification (high-income vs. low- and middle-income countries); geographical region (using WHO geographical regions); and study quality. The presence of publication bias will be assessed using funnel plots. Meta-analyses will be conducted using STATA.

ETHICS AND DISSEMINATION

No primary data is being collected for this study therefore ethical approval is not required. Results of this study will be published in a peer-reviewed publication and presented at conferences. Raw data will be published as supplementary material in the final publication.

DISCUSSION

This systematic review and meta-analysis will produce a synthesis of the available evidence on maternal suicide globally. This will allow comparisons to be made between countries on suicide-related maternal mortality rates and the overall contribution of suicide toward maternal mortality. Summarising the availability and quality of data available in different regions of the world will identify priorities for future research. Identifying countries with high or low maternal suicide rates will also inform future studies of risk factors and preventive interventions in different populations.

There are a number of limitations to this study. It is possible that some of the data retrieved will be of poor quality, limiting its reliability and making comparison between areas challenging. The wide variety of methods and definitions used in studies identifying maternal suicide may also make it difficult to draw direct comparisons, and it may not be possible to calculate pooled estimates. By excluding maternal deaths classified as accidental or injury-related we may be under-estimating the true burden of suicide-related maternal mortality. The lack of data in some regions could also limit the power of analyses. There has also been a difficulty in acquiring the full texts of several of the included abstracts. Every effort was made to identify these texts, however a significant number of texts had to be excluded. This could impact whether we have captured the full breadth of evidence on this topic.

Acknowledgements We would like to thank Ms. Nia Roberts, Senior Outreach Librarian at the University of Oxford Bodleian Health Care Libraries, for her guidance and support in the development of the search strategy for this review.

Data statement No data was gathered for this protocol.

Author contributions ES, SH and GF developed the protocol. ES developed the search strategy with input from SH and GF. ES, JG, SH and GF contributed to screening. ES, JG, SH and GF will conduct data extraction and quality assessment. MQ and FA contributed to the analysis plan. All authors contributed to the writing of this manuscript. SH and GF act as guarantors for the review.

Funding statement: GF is funded by a Clinical Research Fellowship from the Nuffield Department of Population Health, University of Oxford. The funder had no role in the design or development of this protocol.

Competing interests statement: All authors declare no competing interests.

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Figure 1. Definitions of maternal death

- **Maternal death** is defined by the World Health Organization (WHO) as the death of a woman from direct or indirect obstetric causes while pregnant or within 42 days after the end of pregnancy from causes associated with, or exacerbated by, pregnancy or its management, irrespective of the duration or outcome of the pregnancy.[5]
- **Late maternal death** is defined by the WHO as a death of a woman from direct or indirect obstetric causes more than 42 days but less than one year after termination of pregnancy.[5]
- **Comprehensive maternal death** is defined by the International Classification of Diseases (11th Revision) WHO as maternal deaths and late maternal deaths combined.[4]
- **Pregnancy-related death** is defined by the WHO as a death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the cause of death. This definition includes obstetric, non-obstetric, unintentional (accidental) and incidental causes of death.[5]
- **Pregnancy-related death** is defined by the US Centers for Disease Control and Prevention (CDC) as a death during or within one year of pregnancy from a pregnancy complication, a chain of events initated by pregnancy or the aggravation of an unrelated condition by the physiological effects of pregnancy.[6]
- **Pregnancy-associated death** is defined by the CDC as a death during or within one year of pregnancy, regardless of the cause of death.[6]

PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) 2015 checklist: recommended items to address in a systematic review protocol*

Section and topic	Item No	Checklist item	Page Reported
ADMINISTRATIVE INFORMATION			
Title:			
Identification	1a	Identify the report as a protocol of a systematic review	2
Update	1b	If the protocol is for an update of a previous systematic review, identify as such	N/A
Registration	2	If registered, provide the name of the registry (such as PROSPERO) and registration number	2, 3
Authors:			
Contact	3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author	1
Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review	9
Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments	5
Support:			
Sources	5a	Indicate sources of financial or other support for the review	9
Sponsor	5b	Provide name for the review funder and/or sponsor	9
Role of sponsor or funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol	9
INTRODUCTION			
Rationale	6	Describe the rationale for the review in the context of what is already known	3-5
Objectives	7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)	5, 6
METHODS			
Eligibility criteria	8	Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years considered, language, publication status) to be used as criteria for eligibility for the review	6
Information sources	9	Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey literature sources) with planned dates of coverage	6
Search strategy	10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated	Table 1

Study records:			
Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review	6
Selection process	11b	State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis)	7
Data collection process	11c	Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators	7
Data items	12	List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications	7
Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale	7
Risk of bias in individual studies	14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis	8
Data synthesis	15a	Describe criteria under which study data will be quantitatively synthesised	8
	15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any planned exploration of consistency (such as I^2, Kendall's τ)	8
	15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression)	8
	15d	If quantitative synthesis is not appropriate, describe the type of summary planned	8
Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies)	8
Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (such as GRADE)	8

*** It is strongly recommended that this checklist be read in conjunction with the PRISMA-P Explanation and Elaboration (cite when available) for important clarification on the items. Amendments to a review protocol should be tracked and dated. The copyright for PRISMA-P (including checklist) is held by the PRISMA-P Group and is distributed under a Creative Commons Attribution Licence 4.0.**

From: Shamseer L, Moher D, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart L, PRISMA-P Group. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. BMJ. 2015 Jan 2;349(jan02 1):g7647.

BMJ Open

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Manuscript ID	bmjopen-2024-087669.R1
Article Type:	Protocol
Date Submitted by the Author:	31-Jul-2024
Complete List of Authors:	Simmons, Emma; University of Oxford, Medical Sciences Division Gong, Jenny; University of Oxford, National Perinatal Epidemiology Unit, Nuffield Department of Population Health Daskalopoulou, Zoe; University of Oxford, Nuffield Department of Population Health Quigley, Maria; University of Oxford, National Perinatal Epidemiology Unit, Nuffield Department of Population Health Alderdice, Fiona; University of Oxford, National Perinatal Epidemiology Unit, Nuffield Department of Population Health; Queen's University Belfast, School of Nursing and Midwifery Harrison, Sian; University of Oxford, National Perinatal Epidemiology Unit, Nuffield Department of Population Health Fellmeth, Gracia; University of Oxford, National Perinatal Epidemiology Unit, Nuffield Department of Population Health
Primary Subject Heading:	Mental health
Secondary Subject Heading:	Obstetrics and gynaecology, Public health, Global health
Keywords:	Systematic Review, Maternal medicine < OBSTETRICS, Suicide & self-harm < PSYCHIATRY

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Authors
Emma Simmons[1], Jenny Gong[2], Zoe Daskalopoulou[2], Maria Quigley[2], Fiona Alderdice[2,3], Siân Harrison[2], Gracia Fellmeth[2]

Affiliations
1. Medical Sciences Division, University of Oxford, Oxford, UK
2. National Perinatal Epidemiology Unit, Nuffield Department of Population Health, University of Oxford, Oxford, UK
3. School of Nursing and Midwifery, Queen's University Belfast, Belfast, UK

Contact emails
emma.simmons@pmb.ox.ac.uk
jenny.gong@ndph.ox.ac.uk
zoe.daskalopoulou@npeu.ox.ac.uk
maria.quigley@npeu.ox.ac.uk
fiona.alderdice@npeu.ox.ac.uk
sian.harrison@npeu.ox.ac.uk
gracia.fellmeth@ndph.ox.ac.uk

Corresponding author
Gracia Fellmeth
National Perinatal Epidemiology Unit (NPEU)
Nuffield Department of Population Health
University of Oxford
Old Road Campus
Roosevelt Drive
Oxford OX3 7LF
United Kingdom
Tel. 01865 289745
Email: gracia.fellmeth@ndph.ox.ac.uk

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ABSTRACT

Introduction: Maternal suicide is a significant contributor to maternal mortality with devastating consequences for women, families and society. Maternal mortality reporting systems differ across countries and there is no up-to-date overview of maternal suicide deaths globally. This systematic review aims to synthesise the evidence on maternal suicide. The primary objective is to determine the contribution of suicide towards maternal mortality globally and explore differences between geographical regions. The secondary objectives are to summarise the availability and quality of data globally and to describe how suicide deaths are classified across different countries.

Methods and analysis: This protocol follows the Preferred Reporting Items for Systematic Reviews and Meta-analyses for systematic review protocols (PRISMA-P) guidelines. Medline, Embase, PsychINFO, Global Health and CINAHL databases and the grey literature were searched with no date or language restrictions. Observational studies, national surveys and reports that present data on maternal deaths due to suicide occurring during pregnancy, intrapartum and in the post-partum period will be included. Screening, data extraction and quality assessment will be conducted independently by two reviewers. Results will be summarised narratively. If sufficient outcome data is available, random-effects meta-analyses will be conducted to determine global pooled estimates of suicide-related maternal mortality rates and the proportion of maternal deaths attributable to suicide.

Ethics and dissemination: Ethical approval is not required for this systematic review. Results will be written up for publication in a peer-reviewed journal and findings will be shared at national and international conferences.

Prospero registration number: CRD42023429072

ARTICLE SUMMARY

Strengths and limitations of this study

- We will follow rigorous methods and report our methodology and results in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines.
- The search strategy is highly comprehensive and was developed with an experienced university librarian.
- We will conduct the search without language or date limitations, allowing us to include non-English publications which are often omitted in systematic reviews.
- We will conduct an extensive grey literature search to identify non-indexed and non-academic publications including maternal mortality databases and surveillance reports.
- A limitation of our review is that we will exclude maternal deaths due to injury, accidents or substance use.

INTRODUCTION

Rationale

Maternal suicide, defined as death by suicide occurring during pregnancy or within one year of giving birth, is a significant contributor to maternal mortality with devastating consequences for women, families and society. Across a number of high-income countries including the United Kingdom and the USA, suicide is one of the leading causes of maternal death.[1,2] In the UK, the most recent data suggests that between 2019-2021 almost 40% of maternal deaths between six weeks and twelve months after childbirth were due to suicide.[1] In lower-resource settings, where rates of all-cause maternal mortality are often higher overall, the contribution of suicide to maternal deaths is less clear. A previous review reported a maternal suicide prevalence of 1% across low- and middle-income countries (LMIC) with a wide range in prevalence between regions.[3]

Understanding the magnitude of suicide-related maternal mortality is important to improve assessment, identification and reporting of maternal suicide deaths and inform prevention strategies. However, there are a number of challenges in accurately estimating the burden. Firstly, there are a number of different definitions of maternal death (**Figure 1**). The World Health Organization (WHO) uses the terms *maternal death* and *late maternal death*, which are defined in the International Classification of Diseases (11th Revision; ICD-11) and which differ from each other only in terms of the time periods they cover.[4,5] Maternal deaths and late maternal deaths are combined in the ICD-11 under a new grouping of *comprehensive maternal deaths*.[4] Others, notably the US Centres for Disease Control and Prevention (CDC), refer to *pregnancy-associated* and *pregnancy-related deaths*, which both span the same time period but differ according to the designated cause of death.[6] Confusingly, the WHO also refers to *pregnancy-related death*, but defines this term differently from the CDC both in terms of the causes included and the time period covered.[5] In reports and publications presenting maternal death statistics, there is often a lack of clarity around which definition was applied.

Figure 1. Definitions of maternal death
[INSERT Figure 1 here]

Secondly, there are differences in the denominator used to calculate rates of maternal mortality. The commonly reported maternal mortality ratio (MMR) reports the number of maternal deaths during a given time period per 100,000 live births during the same time period.[5] The use of live births as a denominator means that deaths occurring during pregnancy and stillbirths are not captured by the MMR. To address this, some countries such as the UK also report the number of maternal deaths per 100,000 maternities, defined as the number of women giving birth, including stillbirth, at or beyond 24 weeks' gestation.[1] When maternities are used as the denominator, the statistic is often referred to as a maternal mortality *rate* (rather than ratio), but the terminology is inconsistent and in practice the distinction between MMR and maternal mortality rates is often unclear. These differences create challenges when comparing statistics between countries or across different reporting systems.

Thirdly, there is variation in the availability and quality across different regions of the world. High quality data on maternal suicide requires an accurate identification of all maternal deaths, as well as an accurate designation of cause of death. Some countries have systems in place to identify and investigate maternal deaths and their causes at a regional or national level. Such systems include systematic maternal mortality surveillance systems, confidential enquiries and Reproductive Age Mortality Surveys (RAMOS). The assignation of cause of death can include the use of formal death registration certificates and verbal autopsies in which family members are asked to provide information on circumstances around the death. In countries with less robust death reporting systems it is difficult to determine how accurate maternal death reporting is.

A final challenge is the misclassification of deaths by suicide to other causes such as injury or accidents. This is thought to be common given the stigma associated with suicide and its criminalisation in some societies.[3] A review of maternal suicide in LMIC found that reclassifying the leading suicide methods from injuries to suicide increased the pooled prevalence of pregnancy-related suicide deaths from 1.00 to 1.68.[3] Misclassification is compounded by the fact that until the most recent revision of the ICD, maternal suicide did not have a specific code. There has also been a change in the recommended classification of maternal suicides. The ICD-10 categorised maternal deaths due to injuries or mental disorders as indirect maternal deaths.[7] The WHO subsequently published a derivation of the ICD-10: this ICD-Maternal Mortality (ICD-MM) calls for maternal suicides to be classified as direct maternal deaths.[8] This discrepancy has led to variations in the reporting of maternal suicide as direct or indirect causes of death, with some statistics reporting maternal suicide as an incidental cause of death and other statistics excluding suicides from their maternal mortality data altogether.[9]

There are several existing systematic reviews of maternal suicide but these are limited to specific perinatal populations or geographical regions, and there is no up-to-date synthesis of the global evidence for all perinatal women. Lindahl *et al*. (2005) reviewed prevalence of suicide ideation, attempts and deaths in pregnancy and the post-partum period globally; however this included studies published up to 2002 and their findings need updating.[10] Fuhr *et al*. (2014) assessed the contribution of suicide and injuries to perinatal mortality in LMIC only.[3] Amiri *et al*. (2021) assessed rates of suicide ideation, attempts and mortality globally among post-partum women only.[11] Chin *et al*. (2022) reviewed prevalence, risk factors, outcomes and interventions for perinatal deaths by suicide but focused on a limited number of studies that were not included in an earlier review by Mangla *et al*. (2019).[2] Chin *et al*. (2022) also restricted their search to studies published in English, and most of the identified studies were conducted in the USA.[2]

Our systematic review expands upon previous reviews by including suicides occurring during pregnancy and the post-partum period in all countries globally with no language or date restrictions. Results will enable an estimation of the contribution of suicide to maternal deaths globally and a comparison of the burden across geographical regions. Identifying countries reporting either very high or very low rates will inform further work to determine whether differences in rates reflect true differences or reporting- or coding-related factors. Our review will also show whether maternal suicide deaths are reported as direct, indirect or incidental maternal deaths, informing a possible need for further clarification of the ICD-

11 and ICD-MM classifications. Finally, our review will identify countries for which no data on maternal suicide is available, an important requirement in meeting the United Nations' Sustainable Development Goal (SDG) 3.[12]

Objectives

This systematic review aims to identify and synthesise evidence on maternal suicide deaths globally. The primary objective is to determine the contribution of suicide towards maternal mortality and explore differences between geographical regions. The secondary objectives are to summarise the availability and quality of data globally and to describe how suicide deaths are classified across different countries.

METHODS AND ANALYSIS

Registration and protocol adherence

This systematic review protocol is reported in adherence with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for systematic review protocols (PRISMA-P) guidelines (**Supplementary Information S1**).[13] The review was registered on PROSPERO (CRD42023429072) on 25 May 2023. If important amendments to the protocol are required during the course of the review, these will be recorded as amendments on PROSPERO and reported in the final publication as a deviation from the protocol. The start date for the review was January 2023 and the planned end date is July 2025.

Definitions

For the purposes of this review, we define maternal suicide as the death of a woman by suicide at any time during pregnancy, intrapartum or within one year of giving birth. The perinatal period is the period of pregnancy and up to one year after giving birth.

Eligibility criteria

Population, intervention, comparison and outcome framework
The population of interest is women at any stage of pregnancy or within one year of giving birth. The outcome of interest is death by suicide during the perinatal period. There is no intervention or control for this systematic review of global maternal suicide rates.

Inclusion and exclusion criteria
We will include any study that reports data on the number of maternal deaths due to suicide along with appropriate denominator data (either total live births or total maternities during the same time period as maternal deaths). Studies reporting the proportion of all maternal deaths that were due to suicide will also be included. We will include cohort, cross-sectional and case control study designs as well as data from national surveys, databases and reports such as mortality statistics and confidential enquiries. Qualitative studies will be excluded as they are unlikely to contain numerator and denominator data on maternal suicide and maternal death. There will be no minimum threshold applied to the sample size or numbers of suicides reported. Studies that do not report data on the

denominator to allow calculation of the MMR attributable to suicide or the proportion of deaths that are due to suicide will be excluded. Studies in which suicide deaths cannot be differentiated from deaths from injury or other causes will also be excluded. We will include studies published in any language.

Patient and public involvement

There was no patient or public involvement in the design of this systematic review.

Search strategy and data sources

Medline, Embase, PsychINFO, Global Health and CINAHL databases were searched with no date or language restrictions on 5 May 2023. A search strategy using terms relevant to perinatal status, mortality and suicide was developed in collaboration with a university research librarian and adapted for each database. The search strategy used for Medline is shown in **Table 1**. In order to capture relevant evidence not published in the databases above, we conducted an extensive grey literature search. This involved searches of *Google* and *Google Scholar* using the relevant terms listed above to capture non-academic articles such as reports and statistical databases. We also searched the websites of the World Health Organization (WHO), the United Nations Children's Fund (UNICEF), the United Nations Population Fund (UNFPA), UN Women, the World Bank and the Global Burden of Disease Study to identify relevant reports. All records identified by the database search and grey literature searches were combined and duplicates removed using *Endnote*.[14] De-duplicated references were imported into *Covidence* for screening, data extraction and quality assessment.[15] Prior to submitting the review for publication, the search strategy will be re-run to identify any studies published since the original search.

Table 1. Search strategy for Medline

1	Pregnancy/ or Pregnant Women/
2	Postnatal Care/ or Postpartum Period/
3	1 or 2
4	Mortality/
5	3 and 4
6	maternal mortality/ or maternal death/
7	((pregnan* or maternal or postnatal or post-natal or postpart* or post-part*) and (death? or mortality or fatalit*)).ti.
8	((pregnan* or maternal or postnatal or post-natal or postpart* or post-part*) adj3 (death? or mortality or fatalit*)).ti,ab,kf.
9	5 or 6 or 7 or 8
10	"cause of death"/
11	Death Certificates/
12	exp suicide/
13	"cause of death".ti,ab,kf.
14	(suicid* or overdos* or self harm or self injury or violen*).ti,ab,kf.
15	10 or 11 or 12 or 13 or 14
16	9 and 15

Data extraction

Screening of titles and abstracts was performed independently by two reviewers (ES and JG) to exclude studies which did not meet inclusion criteria. Any disagreements were discussed and resolved with a third reviewer (SH and GF). Full-texts were retrieved. Any missing full texts were searched for using a university library database, online journal archives, *Google* and by contacting study authors. Any full-texts that could not be retrieved after this search process were excluded. Full-texts of remaining studies were screened independently by two reviewers (ES, JG, SH, GF) and any disagreements were resolved through discussion. Reasons for excluding full-texts were recorded. Two reviewers (ES, JG, SH, GF) will independently extract data from included studies using a standardised and piloted data extraction form consisting of the following fields:

- **Publication details:** lead author, publication year, publication language
- **Setting:** country, region, type of setting (e.g. hospital or community deaths), dates covered, whether data was collected at national or regional level
- **Participants:** perinatal status (pregnant or post-partum), definition of maternal death used, age, any sociodemographic characteristics (e.g. socioeconomic background, ethnicity, income, parity)
- **Methods of assessment:** method of identifying maternal deaths, method of ascertaining cause of death, classification of suicide (as indirect, direct or incidental cause of death)
- **Outcomes:** total maternal deaths, total live births, total maternities, number of suicide deaths, proportion of deaths due to suicide, accuracy measures (e.g. standard deviation, p-values or 95% confidence intervals), mode of suicide

If reported data is unclear or insufficient, authors of the study will be contacted to request the additional data required for inclusion in the review. Publications in English, French, German, Greek, Italian, Spanish and Portuguese will be assessed by the study authors. For all other languages, translation support will be sought from wider colleagues.

Quality assessment and risk of bias

Two reviewers (ES, JG, SH, GF) will independently assess the quality of each included study. We will use criteria adapted from a study by Grollman and Ronsmans[12] to assess quality and risk of bias. This will include assessment of three domains: quality of the method of death ascertainment; completeness of the cause of death assignation; and quality of the method of assigning cause of death. Each study will be assigned a rating of low, medium or high quality in each of these categories using the attributes outlined by Grollman and Ronsmans.[16] We have chosen this method as there is a precedent for its use in a similar review, and other risk of bias assessment tools have limited application to studies looking at causes of death. Any disagreements will be discussed with the other review authors (FA, MQ) until a consensus is reached.

Data synthesis

A narrative synthesis of included studies will be conducted and a table of study characteristics will be compiled to provide an overview of all included studies. Countries for which data on maternal suicide deaths is available will be mapped and colour-coded (red/amber/green) according to the quality of evidence. The proportion of countries classifying maternal suicide deaths as direct, indirect or incidental deaths will also be reported.

Random-effects meta-analyses will be conducted if numerator and denominator data for the same standardised outcome is reported by at least three studies. The primary outcome will be pooled estimates of suicide-related maternal mortality rates. Depending on the data identified and comparability between studies, we will use either live births or maternities as the denominator or conduct a separate pooled estimate for each. Forest plots will be used to present data visually. Statistical heterogeneity between studies will be calculated using the I^2 statistic. If data allows and sufficient studies are identified, we will carry out subgroup analyses to explore differences in suicide death rates according to perinatal status (pregnancy vs. post-partum); country income classification (high-income vs. low- and middle-income countries); geographical region (using WHO geographical regions); and study quality. The secondary outcome will be a pooled estimate of the proportion of all maternal deaths caused by suicide, using number of suicide deaths as the numerator and total number of maternal deaths as the denominator. If meta-analysis is not possible due to a lack of standardised outcome reporting or due to fewer than three studies presenting the same outcome. The presence of publication bias will be assessed using funnel plots. Meta-analyses will be conducted using STATA.

ETHICS AND DISSEMINATION

No primary data is being collected for this study therefore ethical approval is not required. Results of this study will be published in a peer-reviewed publication and presented at conferences. Raw data will be published as supplementary material in the final publication.

DISCUSSION

This systematic review and meta-analysis will produce a synthesis of the available evidence on maternal suicide globally. This will allow comparisons to be made between countries on suicide-related maternal mortality rates and the overall contribution of suicide toward maternal mortality. Summarising the availability and quality of data available in different regions of the world will identify priorities for future research. Identifying countries with high or low maternal suicide rates will also inform future studies of risk factors and preventive interventions in different populations.

There are a number of limitations to this study. It is possible that some of the data retrieved will be of poor quality, limiting its reliability and making comparison between areas challenging. The wide variety of methods and definitions used in studies identifying maternal suicide may also make it difficult to draw direct comparisons, and it may not be possible to calculate pooled estimates. By excluding maternal deaths attributed to accidents, injury or substance use, we may be under-estimating the true burden of suicide-related maternal mortality. However, given that it is not possible to establish whether these

deaths were intentional or non-intentional, we felt it was a safer and more robust approach to exclude these deaths. The lack of data in some regions could also limit the power of analyses. There has also been a difficulty in acquiring the full texts of several of the included abstracts. Every effort was made to identify these texts, however a significant number of texts had to be excluded. This could impact whether we have captured the full breadth of evidence on this topic.

Acknowledgements We would like to thank Ms. Nia Roberts, Senior Outreach Librarian at the University of Oxford Bodleian Health Care Libraries, for her guidance and support in the development of the search strategy for this review.

Data statement No data was gathered for this protocol.

Author contributions ES, SH and GF developed the protocol. ES developed the search strategy with input from SH and GF. ES, JG, ZD, SH and GF contributed to screening. ES, JG, ZD, SH and GF will conduct data extraction and quality assessment. SH, GF, MQ and FA contributed to the analysis plan. All authors contributed to the writing of this manuscript. SH and GF act as guarantors for the review.

Funding statement: GF is funded by a Clinical Research Fellowship from the Nuffield Department of Population Health, University of Oxford. The funder had no role in the design or development of this protocol.

Competing interests statement: All authors declare no competing interests.

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Figure 1. Definitions of maternal death

- **Maternal death** is defined by the World Health Organization (WHO) as the death of a woman from direct or indirect obstetric causes while pregnant or within 42 days after the end of pregnancy from causes associated with, or exacerbated by, pregnancy or its management, irrespective of the duration or outcome of the pregnancy.[5]
- **Late maternal death** is defined by the WHO as a death of a woman from direct or indirect obstetric causes more than 42 days but less than one year after termination of pregnancy.[5]
- **Comprehensive maternal death** is defined by the International Classification of Diseases (11th Revision) WHO as maternal deaths and late maternal deaths combined.[4]
- **Pregnancy-related death** is defined by the WHO as a death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the cause of death. This definition includes obstetric, non-obstetric, unintentional (accidental) and incidental causes of death.[5]
- **Pregnancy-related death** is defined by the US Centers for Disease Control and Prevention (CDC) as a death during or within one year of pregnancy from a pregnancy complication, a chain of events initated by pregnancy or the aggravation of an unrelated condition by the physiological effects of pregnancy.[6]
- **Pregnancy-associated death** is defined by the CDC as a death during or within one year of pregnancy, regardless of the cause of death.[6]

PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) 2015 checklist: recommended items to address in a systematic review protocol*

Section and topic	Item No	Checklist item	Page Reported
ADMINISTRATIVE INFORMATION			
Title:			
Identification	1a	Identify the report as a protocol of a systematic review	1, 2
Update	1b	If the protocol is for an update of a previous systematic review, identify as such	N/A
Registration	2	If registered, provide the name of the registry (such as PROSPERO) and registration number	2, 5
Authors:			
Contact	3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author	1
Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review	9
Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments	5
Support:			
Sources	5a	Indicate sources of financial or other support for the review	9
Sponsor	5b	Provide name for the review funder and/or sponsor	9
Role of sponsor or funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol	9
INTRODUCTION			
Rationale	6	Describe the rationale for the review in the context of what is already known	3-5
Objectives	7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)	5, 6
METHODS			
Eligibility criteria	8	Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years considered, language, publication status) to be used as criteria for eligibility for the review	5, 6
Information sources	9	Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey literature sources) with planned dates of coverage	6
Search strategy	10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated	Table 1

Study records:			
Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review	6
Selection process	11b	State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis)	7
Data collection process	11c	Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators	7
Data items	12	List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications	7
Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale	8
Risk of bias in individual studies	14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis	7
Data synthesis	15a	Describe criteria under which study data will be quantitatively synthesised	8
	15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any planned exploration of consistency (such as I^2, Kendall's τ)	8
	15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression)	8
	15d	If quantitative synthesis is not appropriate, describe the type of summary planned	8
Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies)	8
Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (such as GRADE)	8

*** It is strongly recommended that this checklist be read in conjunction with the PRISMA-P Explanation and Elaboration (cite when available) for important clarification on the items. Amendments to a review protocol should be tracked and dated. The copyright for PRISMA-P (including checklist) is held by the PRISMA-P Group and is distributed under a Creative Commons Attribution Licence 4.0.**

From: Shamseer L, Moher D, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart L, PRISMA-P Group. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. BMJ. 2015 Jan 2;349(jan02 1):g7647.