What is the evidence on the number of pregnancies/live births that result in obstetric complications and require referral to specialist care?

A RAPID LITERATURE REVIEW
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What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.

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Acknowledgements:

Our appreciation is extended to Hannah Wood, Information Specialist and Julie Glanville, Project Director (Information Services) at York Health Economics Consortium, for their support in the development of the search strategy.

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Table of Contents

1 Summary ........................................................................................................................................ 3
2 Introduction .................................................................................................................................... 5
  2.1 Rationale ................................................................................................................................... 5
  2.2 Objective .................................................................................................................................. 9
3 Methods .......................................................................................................................................... 9
  3.1 Eligibility criteria ..................................................................................................................... 9
  3.2 Information sources .................................................................................................................. 10
  3.3 Search strategy ......................................................................................................................... 10
  3.4 Study selection .......................................................................................................................... 10
  3.5 Data collection process ............................................................................................................. 11
  3.6 Data items ................................................................................................................................. 11
  3.7 Risk of bias in individual studies ............................................................................................. 11
  3.8 Summary measures/ Synthesis of results .................................................................................. 11
  3.9 Risk of bias across studies ....................................................................................................... 11
4 Results ........................................................................................................................................... 12
  4.1 Study selection .......................................................................................................................... 12
  4.2 Study characteristics ............................................................................................................... 13
  4.3 Risk of bias within studies ....................................................................................................... 14
  4.4 Results of individual studies .................................................................................................... 14
  4.5 Synthesis of results .................................................................................................................. 18
5 Discussion ....................................................................................................................................... 18
  5.1 Summary of evidence ............................................................................................................... 18
  5.2 Limitations ............................................................................................................................... 20
  5.3 Issues arising ............................................................................................................................ 20
6 Conclusions ..................................................................................................................................... 22
  6.1 Next steps .................................................................................................................................. 22
7 Funding .......................................................................................................................................... 23
8 Annexes .......................................................................................................................................... 24
  Annex 1. Conceptual graphic of emergency complications ............................................................. 24
  Annex 2. Search strategy ................................................................................................................ 25
  Annex 3. Extraction tool ............................................................................................................... 29
  Annex 4. Extraction process ......................................................................................................... 30
  Annex 5. Summary characteristics of studies .............................................................................. 31
  Annex 6 Bibliography of articles retrieved for evaluation .............................................................. 44
What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.

1 Summary

Objective: To summarise the evidence from articles published in peer-reviewed journals on the estimated proportion of pregnancies that give rise to obstetric complications, in order to inform benchmarks for maternal and newborn health (MNH) policy and programming.

Methods: A rapid literature review was conducted, searching for relevant studies published during the 10-year period since 2002. Articles obtained from the search and subsequent screening process were reviewed using a pre-defined extraction tool. The tool focused on obstetric complications as defined by UNFPA/WHO/UNICEF: haemorrhage (antepartum or postpartum); prolonged or obstructed labour; postpartum sepsis; complications of abortion; pre-eclampsia/eclampsia; ectopic pregnancy; and ruptured uterus.

Results: 53 studies were included in the final analysis, with 42 providing data on at least 1 of the UNFPA/WHO/UNICEF recognized obstetric complications. The results indicate that the more prevalent obstetric complications show greater variation; there is less variation for complications that are rarer. Excluding highest and lowest values, articles relating to postpartum sepsis yielded a range of prevalence/incidence of 0.5-1.1 per 1000 deliveries, eclampsia 1-9 per 1000 deliveries and ruptured uterus 0.1-7 per 1000 deliveries. Ranges for hypertensive disorders were much greater (4.3-97, mean 39.9 per 1000 deliveries). Prolonged/obstructed labour findings varied from 19-78 per 1000 deliveries, mean 45.5/1000 deliveries. Means for rates of haemorrhage per 1000 deliveries also varied across three classifications of antepartum, postpartum and general haemorrhage. Greater consistency was found across studies that differentiated between antepartum (mean 32.8/1000 deliveries, range 16.0-50.0/1000 deliveries) and postpartum haemorrhage (mean 36.8/1000 deliveries, range 20.0.0-67.0/1000 deliveries).

Discussion: The retrieved articles were not greatly comparable in the chosen obstetric complications, leading to a number of issues in trying to appreciate potential incidence/prevalence trends across studies that might lend themselves to the creation of global estimates. Few published studies were conducted with the intention to provide globally applicable data on the prevalence/incidence of obstetric complications; studies focus exclusively on facility deliveries – even in regions/countries where the majority of births take place outside facilities; the lack of uniformity in diagnostic criteria for identifying and classifying obstetric complications constitutes an important technical complication; prevalence and incidence are used interchangeably, and at times inconsistently, across studies; and, certain complications were more commonly studied than others. The exclusive consideration of published, peer-reviewed articles with predominant focus on facility deliveries almost certainly does not provide an accurate reflection of the rates at which obstetric complications are occurring throughout the world and across settings. Publications tend to evaluate limited populations in specific settings; they are rarely population-based and more commonly facility-based. The complexity of obstetric complications adds further to the complexity of studying this subject. Obstetric complications are often the result of multiple and dynamic factors, such as pre-existing health, age and obstetric risk combined with key social and societal components such as life-style and habits, socio-economic status, care-seeking behaviours and access to timely and effective care. The intricate interconnections between these factors raise the question whether a uniform benchmark for human resource planning of the needed workforce with obstetric skills is both feasible and appropriate. Creating a universal benchmark for the productive capacity of the obstetric health-workforce based on the global prevalence of obstetric complications may ignore the multiple variables that impact this metric.

1 As both incidence and prevalence are addressed across the body of literaturna included in the review the phrasing “incidence/prevalence” is used.
What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.

Conclusions: We conclude that there is a continued lack of empirical evidence to support the discussion on the incidence of obstetric complications. This impedes the current work on health systems and human resources benchmarking. Further discussion is needed on whether and how to adjust these gaps in knowledge to usefully inform the next steps in benchmark development, or whether to accept the limitations and work on both top-down and bottom-up workforce planning models for a ‘typical’ district population. A uniform method for reporting on obstetric complications would allow for better estimates of prevalence/incidence and MNH workforce requirements.
Introduction

2.1 Rationale

The World Health Organization (WHO) is currently reviewing the benchmarks that are utilized for policy and planning of maternal and newborn health (MNH) services. One of the benchmarks flagged for review is the number/frequency of pregnancies/live births that give rise to obstetric complications.

WHO, UNICEF and UNFPA guidelines currently cite the benchmark of 20% of pregnancies/15% of live births for obstetric complications. This figure is based on sources from the 1970s and 1980s and has been questioned. Critics argue that it is not supported by empirical evidence. A WHO Technical Working Group has described it as a “guestimate” which is possibly underestimating incidences of complications. Pittrof and Campbell (2000) describe it as having a “weak” empirical basis and, similarly, Ron sms et al. (2002) indicate that this figure has never been empirically verified.

To support WHO’s discussions on the validity, or otherwise, of the current benchmark, a rapid literature review was commissioned by WHO to collate available evidence on the metric and inform any potential revision. The rapid review was conducted in the period November 2012 – January 2013 for reporting in February 2013. Preliminary findings were discussed at an expert meeting in Geneva on 4 December 2012.

2.1.1 Defining ‘obstetric complications’

There are several definitions of “obstetric complications” in the literature. This review will use the UNFPA/WHO/UNICEF definition of “complicated cases” which includes the following conditions that can arise during the obstetric period (which includes pregnancy, birth, and the postpartum period or puerperium): haemorrhage (antepartum or postpartum); prolonged or obstructed labour; postpartum sepsis; complications of abortion; pre-eclampsia/eclampsia; ectopic pregnancy; and ruptured uterus (see Table 1).

These complications are all direct causes of obstetric death and morbidity. In addition to this, obstetric death and morbidity can also be caused by indirect causes, due to existing medical conditions that are aggravated by pregnancy or delivery. Some authors indicate that these indirect causes, such as anaemia, malaria and tuberculosis, should also be a part of the definition of obstetric

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6 Pittrof, R. & Campbell, O., 2000. Quality of Maternity Care: Silver Bullet or Red Herring? London: Maternal Health Programme, Department of Infectious and Tropical Diseases, London School of Hygiene & Tropical Medicine.
What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.

However, the inclusion of indirect causes lies beyond the scope of this current review.

| Table 1: Complications by stage of the obstetric period |
|---------------------------------|------------------|
| Stage                           | Condition        |
| Antepartum                      | AP haemorrhage   |
| Antepartum                      | Pre-eclampsia/ eclampsia |
| Antepartum                      | Ectopic pregnancy |
| Antepartum                      | Complications of abortion |
| Intrapartum                     | Prolonged labour |
| Intrapartum                     | Obstructed labour |
| Intrapartum                     | Pre-eclampsia/eclampsia |
| Intrapartum                     | Ruptured uterus  |
| Post partum                     | Postpartum haemorrhage |
| Post partum                     | Pre-eclampsia/eclampsia |
| Post partum                     | Postpartum sepsis |

2.1.2 Existing research

Research to date on the topic tends to focus mostly on complications that are severe, life-threatening, and/or require emergency obstetric interventions. Several different approaches have been used to look at this subset of severe complications, including Absolute Maternal Indications and Severe Acute Maternal Morbidity (SAMM) or “near misses”.

Absolute Maternal Indications

Various authors, including the Unmet Obstetric Need (UON) Network, use the concept of Absolute Maternal Indications (AMI). AMI are defined as life-threatening complications that have a high likelihood of resulting in maternal death or permanent morbidity unless the patient has timely access to a Major Obstetric Intervention (MOI). 11,12,13 There are several different definitions of what constitutes an AMI, with no clear consensus (see Table 2 below). 14,15 For further details on AMI and MOI, see annex 7.

| Table 2: Classifications of obstetric complications |
|---------------------------------|------------------|------------------|------------------|
| Study                           | Indicator of complications | Obstetric | Conditions included |


What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.

<table>
<thead>
<tr>
<th>Study</th>
<th>Indicator of obstetric complications</th>
<th>Conditions included</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prytherch, H. et al., 2007. The unmet need for emergency obstetric care in Tanga Region, Tanzania. BMC Pregnancy and Childbirth, 7, p.16.</td>
<td>Absolute Maternal Indication</td>
<td>Antepartum haemorrhage due to placenta praevia or abruptio placentae; malpresentation (transverse lie, brow presentation, etc.); ruptured uterus; cephalo-pelvic disproportion/obstructed labour based on partograph with action line crossed by the dilation line.</td>
</tr>
<tr>
<td>Belghiti, A. et al., 1998. Monitoring unmet obstetric need at district level in Morocco. Tropical Medicine &amp; International Health, 3(7), pp.584–91.</td>
<td>Absolute Maternal Indication</td>
<td>Severe antepartum haemorrhage; placenta praevia and abruptio placentae; severe postpartum haemorrhage requiring surgical intervention; foeto-pelvic disproportion, including pre-rupture and uterine rupture; shoulder or transverse lie and brow presentation.</td>
</tr>
</tbody>
</table>

Near misses
Another concept used to examine severe obstetric complications is that of “near misses” or severe acute maternal morbidity (SAMM). A near miss is the survival outcome of a life-threatening complication, or “a very ill woman who would have died had it not been that luck or good care was on her side”. For the purposes of our assessment, near misses are important to understanding the overall prevalence/incidence of complications, but only constitute a part of the whole picture, as they are the subset of those complications that become life-threatening but do not result in maternal mortality (see Figure 1 below).

Figure 1: AMI and Near Misses

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What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.

(Figure not representing proportions)

In the sense that Absolute Maternal Indications are defined as life-threatening complications (see above), then near misses can be understood as a subset of AMI. Based on this understanding, an AMI is a specific case of a life-threatening complication, and a near miss is one of the possible outcomes to this complication (the other being maternal death).

However, caution must be exercised when trying to reconcile the concepts in this way. As discussed above, different studies use different definitions of AMI, and the same is true for near misses.

To avoid confusion over the different classifications of maternal morbidity / pregnancy complications in the literature, the extraction framework of this literature review includes an assessment of the exact definitions used by each of the studies surveyed. This serves to avoid problems of cross-comparability of the data.

Existing systematic reviews
Several systematic reviews have been conducted to date on the topic of obstetric complications. Minkauskiene et al. (2004) use the concept of severe maternal morbidity for their systematic review, which looks at the prevalence of severe complications, possible risk factors and related medical interventions.19 This review also notes the use of overlapping terminology in the literature, such as “cases of ‘near miss’, morbidity of severe obstetric disease, morbidity of acute severe obstetric disease, morbidity of severe disease of pregnant and labouring women”. Say, Pattinson and Gülmezoglu (2004) conduct a review of SAMM or “near miss”, and note the difficulties in pooling data or establishing comparisons due to the variations in case identification.20 Another systematic review conducted by Hofmeyr, Say and Gülmezoglu (2005) is limited to studying the prevalence of uterine rupture only.21

What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.

Thus, the current literature lacks a review that looks at the overall incidence of complications during pregnancy and not exclusively at severe or life-threatening complications. This review will also recognize that the prevalence of obstetric complications cannot be separated from the wider context of biological, cultural, socioeconomic, and other underlying factors which influence a woman’s likelihood of suffering an obstetric complication (see figure in Annex 1). Recognizing that obstetric complications can depend on genetic factors,\textsuperscript{22} health status,\textsuperscript{23,24,25} reproductive status (including age and parity)\textsuperscript{26} and access to health services,\textsuperscript{27} which in turn depend on underlying social, cultural and economic factors, it must be acknowledged that this review may not uncover a universal rate of prevalence, but rather highlight that prevalence is dependent on the specific characteristics of different populations.

2.2 Objective
The objective of this rapid literature review is to inform benchmarks for maternal and newborn health (MNH) policy and programming. It has particular relevance for low- and middle-income countries and the required infrastructure and staffing to provide quality emergency obstetric care services. It seeks to identify, collate and summarise evidence on the estimated number, proportion, and/or frequency of both pregnancies and live births that are affected by obstetric complications.

3 Methods

3.1 Eligibility criteria
The rapid review focused on published, peer-reviewed publications. Grey literature, including Emergency Obstetric Care (EmOC) assessments conducted within low- and middle-income countries, using standard methods developed by UNFPA, WHO and the Averting Maternal Death and Disability (AMDD) programme at Columbia University, were therefore excluded.\textsuperscript{28}

The search strategy concentrated on new literature from 2002 onwards, to complement observations of Ronsmans et al.\textsuperscript{29} which explored evidence published prior to that point in time. There was no limit on the time period covered by the data retrieved.

3.2 Information sources
We searched EMBASE, LILACS and MEDLINE for all papers in the 10-year period from 2002. These were selected based on the findings of the 2004 World Health Organization systematic review of maternal mortality and morbidity.\textsuperscript{30} This paper discussed the utility of information resources in this

\textsuperscript{25} Mulligan, J. et al., 2010. Improving Reproductive, Maternal and Newborn Health: Burden, Determinants and Health Systems. Evidence Overview, London: DFID.
\textsuperscript{28} A synthesis of all available EmOC assessments has been commissioned by UNFPA and will potentially be available in 2013 to add to the evidence base.
\textsuperscript{30} Gülmezoglu, a M. et al., 2004. WHO systematic review of maternal mortality and morbidity: methodological issues and challenges. BMC Medical Research Methodology, 4, p.16.
What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.

The search strategy was developed and iteratively refined through testing/re-testing to improve its precision, as an original version of the strategy identified 18'894 peer-reviewed articles. Adaptions were tested against published, relevant systematic reviews to check that sensitivity was preserved. The original MEDLINE search was adapted for the other search resources. The full search strategy is available as Annex 2.

3.4 Study selection
Records retrieved from the search were subject to two successive screenings. For the first of these, records were screened against two eligibility criteria:

1. Does the study refer to incidence/prevalence rates of obstetric complications?
2. Is the number of study participants greater than 500?

For this screening, records were categorized according to the search terms that retrieved them. Those identified from higher priority search terms ("obstetric complications" or "morbidity") were subject to a title and abstract review. Those identified from lower priority search terms (all other search terms) were subject to an initial title review and an abstract review where necessary.

The second screening, given the scope of the rapid review, aimed to:
- Identify records meeting the inclusion criteria, i.e., with reference to any of the following obstetric complications (as per the UNFPA, WHO and UNICEF definition): haemorrhage (antepartum or postpartum); prolonged or obstructed labour; postpartum sepsis; complications of abortion; pre-eclampsia/eclampsia; ectopic pregnancy; and ruptured uterus.
- Exclude any records referring to sources from which complete data could not be extracted. Records were excluded if they referred to studies not in the English language, to studies that were irretrievable, or to poster abstracts.

For all records passing the two successive screening processes (i.e. meeting both eligibility and inclusion criteria), the full text was retrieved for data extraction.

3.5 Data collection process
Full-text articles obtained after the screening process were reviewed against a predefined extraction tool (see Annex 3). The tool contains three sections, covering the general characteristics of the study; prevalence or incidence rates of obstetric complications/obstetric morbidity; and a quality assessment. This tool is based on the data extraction form developed for the 2004 WHO systematic review of maternal mortality.


What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.

review of maternal mortality and morbidity.\textsuperscript{35} Data extraction of the selected articles went through a three-tiered process of initial data extraction, second detailed revision and extraction of all articles by a second reviewer, and final evaluation by a third reviewer.

3.6 Data items
Data were extracted for UNFPA/WHO/UNICEF recognized categories of obstetric complications. Where possible, prevalence/incidence was calculated in relation to the number of deliveries, given that most of the articles used this measure rather than pregnancies, live births or population. Obstetric complications studied were the following: antepartum haemorrhage, postpartum haemorrhage, haemorrhage (in studies that did not specify whether antepartum or postpartum); prolonged or obstructed labour; postpartum sepsis; complications of abortion; hypertensive disorders excluding eclampsia; eclampsia; ectopic pregnancy; ruptured uterus.

3.7 Risk of bias in individual studies
The data extraction tool included questions relevant to potential bias in individual studies, including consideration of sampling methods, eligibility and exclusion criteria, data sources, population characteristics, diagnostic criteria, health characteristics of those included in the study and conditions that may contribute to the presence or absence of obstetric complications.

3.8 Summary measures/ Synthesis of results
Data regarding incidence/prevalence of the selected obstetric complications were evaluated as presented in each of the selected articles and then, where possible, converted to cases of each obstetric complication per 1000 deliveries\textsuperscript{36}. When possible, data given as percentages were confirmed by recalculating cases over study population prior to conversion per 1000 deliveries. For each complication, the maximum, minimum, median and mean values were calculated. To reduce the effect of potential outliers, a second analysis was done in which the maximum and minimum values were taken away prior to calculating the mean and range.

Some studies combined hypertensive disorders into one condition, while others provided separate data regarding rates of pregnancy-induced hypertension/gestational hypertension, pre-eclampsia and/or eclampsia. To allow for appropriate comparison, two variables were created: hypertensive disorders of pregnancy and eclampsia. Cases of hypertensive disorders of pregnancy per 1000 deliveries were calculated by adding the total number of cases of hypertension/gestational hypertension and pre-eclampsia over the study population and expressed as cases per 1000 deliveries. Eclampsia was kept separate as prevalence/incidence of eclampsia is much lower than other hypertensive disorders of pregnancy. Similarly, haemorrhage was treated as three variables: antepartum haemorrhage, postpartum haemorrhage and haemorrhage, depending on how the data were presented in the article. Dystocia, and prolonged and obstructed labour were considered as one variable.

3.9 Risk of bias across studies
Given the rapid nature of this review to inform ongoing discussions on benchmarks for MNH, a full assessment of methodological bias across the studies was not conducted. However, given that most of the studies analysed refer to measured rates of prevalence in individual settings, rather than


\textsuperscript{36} With the exception of ectopic pregnancy and complication of abortion which were presented as per 1000 pregnancies, with the exception of Mbele et al which did include data for “critically ill” (as a result of abortion)/1000 births
What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.

distributions across populations, issues of statistical bias are not highly relevant. This issue is addressed in further detail in the Results and Discussion sections of this paper.

4 Results

4.1 Study selection

The search retrieved 4’416 records (2’017 for MEDLINE, 1’527 for EMBASE and 872 for LILACS). 1’256 duplicates were identified using Mendeley’s bibliography management software\(^{37}\), resulting in 3’160 original records for screening on their relevance to the review.

A total of 324 records passed the first screening process. Records excluded failed to meet the two eligibility criteria, i.e. they did not refer to prevalence/incidence rates of obstetric complications and/or did not include more than 500 cases.

A second screening was conducted to identify those records with reference to obstetric complications, as defined by the UNFPA/WHO/UNICEF\(^ {38}\): haemorrhage (antepartum or postpartum); prolonged or obstructed labour; postpartum sepsis; complications of abortion; pre-eclampsia/eclampsia; ectopic pregnancy; ruptured uterus; and to also exclude those records from which it was not possible to extract data. At this stage, 256 records were excluded for not meeting the inclusion criteria (i.e. referring to the abovementioned complications), with the additional exclusion of four records unavailable in English language, two records not obtainable in any format, and two records referring to poster abstracts rather than published articles. These exclusions resulted in a final selection of 60 articles that were retrieved for a detailed evaluation.

Data were extracted from these 60 articles, with 53 providing data against at least one of the UNFPA/WHO/UNICEF recognized categories for obstetric complications. The seven remaining articles were: four which did not address any of the WHO obstetric complications as defined by this review; two which contained no data on prevalence/incidence; and one article which was found to have a sample size of fewer than 500 participants. These records had not been removed earlier in the screening process as their abstracts did not make these limitations clear, which only became apparent upon full review of the text.

Of the 53 studies providing data, 42 contained data that could be converted to cases per 1000 deliveries by complication, for an initial descriptive analysis. Data from the remaining 11 studies were also considered to assess consistency with the findings of the 42 studies. The study selection process is shown in Figure 2 below.

\textbf{Figure 2. Study selection}

\(^{37}\) Mendeley Ltd., Mendeley Desktop.

What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.

4.2 Study characteristics

Key characteristics from the final selection of 53 studies are summarized in Annex 5. The studies cover various geographical areas: North America leads with 12 studies, followed by Asia (Southeast Asia and Eurasia included) with 11 studies. There are 9 studies from Africa and 8 from Europe, 5 from Latin America, 4 from the Middle East and 2 studies from Oceania. Finally, 2 studies include a combination of regions.

The split between low-income and high-income countries is 33 studies from high-income countries (according to the World Bank classification of high-income and upper-middle-economies)\(^\text{39}\), 15 low-income countries (according to World Bank classification of low-income and lower-middle-income economies)\(^\text{40}\) and 5 studies containing a mixture of countries from both high-income and low-income countries.

None of the articles addressed the complete group of obstetric complications, as defined by UNFPA/WHO/UNICEF, and only 8 studies looked at more than three complications. One study from


What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.

Nigeria (Akwuruoha et al. 2011), looked at 18 complications (five of which are included in this analysis), but was restricted to one facility in one city, reducing its representativeness for the full Nigerian population.

Population sizes vary widely between the papers, from almost 40 million in an American study, to just over 500 in a study from Belgium.

Table 3: Studies classified by obstetric complication

<table>
<thead>
<tr>
<th>Complication</th>
<th>Number of articles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complications of abortion</td>
<td>4</td>
</tr>
<tr>
<td>Ectopic pregnancy</td>
<td>3</td>
</tr>
<tr>
<td>Pre-eclampsia/pregnancy-induced hypertension</td>
<td>28</td>
</tr>
<tr>
<td>Eclampsia</td>
<td>14</td>
</tr>
<tr>
<td>Antepartum haemorrhage</td>
<td>10</td>
</tr>
<tr>
<td>Postpartum haemorrhage</td>
<td>14</td>
</tr>
<tr>
<td>Haemorrhage (obstetric, unspecified)</td>
<td>6</td>
</tr>
<tr>
<td>Prolonged/obstructed labour</td>
<td>9</td>
</tr>
<tr>
<td>Ruptured uterus</td>
<td>17</td>
</tr>
<tr>
<td>Postpartum sepsis</td>
<td>8</td>
</tr>
</tbody>
</table>

4.3 Risk of bias within studies
Some of the studies are based on self-reported data. In one study, this was validated by a physician, but included ‘complications’ like postpartum insomnia and breastfeeding problems. Another study, which included interviews at multiple points of the pregnancy and postpartum period, included postpartum physician examinations at 14-22 days postpartum, though these were not intended to validate self-reported complications. Including self-reported rates of complications may influence the results of this review, as their inclusion could increase the likelihood of misdiagnosis of obstetric complications. However, the exclusion of articles with self-reported data may introduce bias favouring information on hospital births, as existing files on deliveries occurring out of hospital may not be readily accessible.

4.4 Results of individual studies
Table 4 shows the results of the 53 articles included in the study against the agreed obstetric complications.

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<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Year</th>
<th>Unit (delivery/pregnancy/live birth/vaginal birth/ etc)</th>
<th>Group</th>
<th>Rate per 1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agrawal, S., Agarwal, A. &amp; Das, V.</td>
<td>2011</td>
<td>deliveries</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Akewuruoha, E. et al.</td>
<td>2011</td>
<td>deliveries</td>
<td></td>
<td></td>
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<tr>
<td>Al-Mulhim, A-A et al.</td>
<td>2003</td>
<td>deliveries</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ali, A. A. et al.</td>
<td>2012</td>
<td>deliveries</td>
<td></td>
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<tr>
<td>Almerie, Y. et al.</td>
<td>2010</td>
<td>deliveries</td>
<td></td>
<td></td>
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<td>Bang, R. A. et al.</td>
<td>2004</td>
<td>deliveries</td>
<td></td>
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<tr>
<td>Baskett, T.F. &amp; O’Connell, C.M.</td>
<td>2005</td>
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<tr>
<td>Brosens, I. A., et al.</td>
<td>2007</td>
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</tr>
<tr>
<td>Clausen, T. et al.</td>
<td>2006</td>
<td>deliveries</td>
<td></td>
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<td>Cleary-Goldman, J. et al.</td>
<td>2005</td>
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<td>2010</td>
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<td>Daniel, I. et al.</td>
<td>2003</td>
<td>deliveries</td>
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<td>Elsken, E. et al.</td>
<td>2006</td>
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Table 4. Rates of obstetric complications in the 53 selected articles
<table>
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<tr>
<th>Author(s)</th>
<th>Year</th>
<th>Unit (delivery/pregnancy/live birth/vaginal birth/etc)</th>
<th>Group</th>
<th>Rate per 1000</th>
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<td>Haemorrhage</td>
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<td></td>
<td>Postpartum haemorrhage</td>
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<td></td>
<td>Antepartum haemorrhage</td>
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<td></td>
<td>Prolonged/obstructed</td>
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<td></td>
<td></td>
<td></td>
<td>labour</td>
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<td></td>
<td></td>
<td></td>
<td>Postpartum sepsis</td>
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<td></td>
<td>Complications of</td>
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<td></td>
<td></td>
<td>abortion</td>
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<td>Hypertensive disorders</td>
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<td></td>
<td>of pregnancy</td>
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<td>(HTN disorders, PIH,</td>
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<td></td>
<td>preeclampsia)</td>
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<td></td>
<td>Eclampsia</td>
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<td></td>
<td>Ectopic pregnancy</td>
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<td></td>
<td>Ruptured uterus</td>
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<td>Any or combination of</td>
<td></td>
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<td></td>
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<td>Galambosi, P.J. et al.</td>
<td>2012</td>
<td>deliveries</td>
<td></td>
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<tr>
<td>Geller, E. et al.</td>
<td>2010</td>
<td>deliveries</td>
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<td>Healy, D.L. et al.</td>
<td>2010</td>
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<td>Hofmeyr, G. J., Say, L., &amp; Gulmezoglu, A. M</td>
<td>2005</td>
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<td>Hoque, M.</td>
<td>2011</td>
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<td></td>
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<td>Huda, F. A. et al.</td>
<td>2012</td>
<td>deliveries</td>
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<tr>
<td>Islam, M. A. et al.</td>
<td>2004</td>
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<td>Kaye, D. et al.</td>
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<td>Liu, S. et al.</td>
<td>2010</td>
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<td>Lumbiganon, P. et al.</td>
<td>2010</td>
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<td>Matsuda, Y. et al.</td>
<td>2011</td>
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<td>Mbele, A.M., Snyman, L. &amp; Pattison, R.C.</td>
<td>2006</td>
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<td>Miller, S. et al.</td>
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<td>Myles, T.</td>
<td>2003</td>
<td>deliveries</td>
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<td>Nomura, R. et al.</td>
<td>2004</td>
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<tr>
<td>Author(s)</td>
<td>Year</td>
<td>Unit (delivery/ pregnancy/ live birth/ vaginal birth/ etc)</td>
<td>Group</td>
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<tr>
<td>Ould El Joud, D. et al.</td>
<td>2002</td>
<td>deliveries</td>
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<td>Ozdemir, I., Yucel, N. &amp; Yucel, O.</td>
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<td>Rizwan, N., Abbasi, R.M. &amp; Uddin, S.F.</td>
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<td>Rode, L. et al.</td>
<td>2005</td>
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<td>Roman, H. et al.</td>
<td>2007</td>
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<td>Ronsmans, C. et al.</td>
<td>2009</td>
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<td>Rouzi, A.A. et al.</td>
<td>2003</td>
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<td>Salihu, H. M. et al.</td>
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<td>Villar, J. et al.</td>
<td>2007</td>
<td>deliveries</td>
<td></td>
<td>-</td>
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<td>Walker, M. C. et al.</td>
<td>2004</td>
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<td>Zhang, W. H. et al.</td>
<td>2005</td>
<td>deliveries</td>
<td></td>
<td>4.6</td>
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</table>

HTN= hypertensive. PIH = pregnancy-induced hypertension.  
* combines hypertensive disorders of pregnancy including eclampsia  
** median for pregnant population  
*** critically ill per 1000 births
4.5 Synthesis of results
Evaluation of the 42 articles with data converted to cases per 1000 showed great heterogeneity between studies, even after omitting the maximum and minimum values as potential outliers. Variation was greater for the more prevalent obstetric complications whereas complications that are rarer had tighter margins. For example, postpartum sepsis yielded a range of prevalence/incidence of 0.5-1.1 (mean 0.82; median .9) per 1000 deliveries, eclampsia 0.3-14 (mean 4.3; median 3.7) per 1000 deliveries and ruptured uterus 0.3-7 (mean 2.0; median 1) per 1000 deliveries. The diagnosis “hypertensive disorders” had much greater variation (4.3 – 120; mean 52; median 42.76) per 1000 deliveries. Prolonged/obstructed labour varied from 19-78 (mean 42.2; median 29.1) per 1000 deliveries. And the means for rates of haemorrhage per 1000 deliveries also varied across the three classifications as follows: non-specific obstetric haemorrhage (range 11.4-19.7; mean 15.55; median 15.55 per 1000 deliveries), antepartum haemorrhage (range 16.0-60.0; mean 32.8; median 29.5 per 1000 deliveries) and postpartum haemorrhage (range 8-57.6; mean 33.3; median 32 per 1000 deliveries).

A few articles containing data that could not be converted to rates per 1000 deliveries were considered and also showed great heterogeneity. Included in this analysis is a systematic review by Kaye et al. (2011)46 on severe maternal morbidity in sub-Saharan Africa. This study found wide variation across rates of haemorrhage ranging from 3 – 302/1000 deliveries47 across the study populations. A study of self-reported conditions from DHS surveys in Brazil by Souza et al. (201048) reported that 18.4% of women surveyed claimed to have had obstetric haemorrhage during their pregnancy (184/1000), a rate well above other studies. Kaye et al. (2011) also found wide ranges (20.5-201/100049) in rates of prolonged/obstructed labour across the articles included in their systematic review. Rates for complications of abortion were addressed in four studies and ranged from 13-86 per 1000 pregnancies. A study by Mebele et al. (2006)50 reported that abortion led to critically ill outcomes in 2.92/1000 births and 3.05/1000 births over the two periods studied. Rates for ectopic pregnancy were discussed in three studies with a fairly tight range of 9 – 16.6 /1000 pregnancies. Three studies51,52,53 provided data on grouped obstetric complications with rates ranging from 229/1000 pregnancies, 914/1000 pregnancies and 340/1000 deliveries.

5 Discussion

5.1 Summary of evidence
This rapid review of published peer-reviewed papers on obstetric complications has given insight into ranges of occurrence per complication despite the fact that none of them were specifically designed to report on prevalence or incidence of complications on a global level. The two systematic reviews included in the analysis provide additional insight into the difficulty of appreciating the incidence/prevalence of obstetric complications through the analysis of published, peer-reviewed

47 Data from deliveries only
49 Data includes pregnancies, deliveries and live births
What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.

articles which are targeted to answer different research questions. Hofmeyr et al. (2005)54 focused on the single complication of ruptured uterus and found wide variation across countries in function of their level of development, with rates ranging from 0.006-0.92% in developed countries, 0.1-19% in less developed countries and 0.21-25% in the least developed countries55. It is noteworthy that the width of the range increases greatly in lesser and least developed countries. This speaks to concerns identified by Kaye et al. (2011)56 that the contexts and settings may greatly impact outcomes and that variations in criteria may impede the ability to fully understand the true scope and nature of maternal morbidity across populations. Kaye et al. (2011) also propose the formation of a classification system so that comparisons between countries and regions may be understood and addressed. It should be noted that, for the purposes of the data synthesis, these systematic reviews were not included as the data could not be converted to rates per 1000 deliveries, which also avoided issues that could have arisen with double-counting the data.

The roles that socio-economic status, non-obstetric health conditions and obstetric risk factors may play in the incidence of obstetric complications across populations can also be observed through the identified studies. Clausen et al. (2006)57 examine how low socio-economic status is linked to higher rates of obstetric complications in urban neighbourhoods of Oslo, considering factors such as educational status, marital status and age. These authors also consider lifestyle habits such as smoking and confirm the relationship between pre-conceptual body mass index (BMI) and the risk of complications during pregnancy. Roman et al. (2007)58 also focused on the negative impact of obesity, but also considered lifestyle habits, such as smoking and drinking alcohol, as well as pre-existing health conditions, such as chronic hypertension and chronic diabetes. Guendelman et al. (2006)59 focused on variations in rates of obstetric complications for women of various ethnicities in California (USA) and found black women to have greater rates of obstetric complications, and Latina women to have lower rates, compared to white women and Asian women. Bruce et al. (2008)60 and Bruce et al. (2012)61 also supplied data on race/ethnicity in relationship to rates of obstetric complications. Maternal age as an obstetric risk factor is considered in several studies. Cleary-Goldman et al. (2005)62 found that women aged 35-39 years and over 40 years had much greater odds of having an obstetric complication (adjusted OR 2.0 and 2.4, respectively) than women under the age of 35. On the other side of the spectrum, Hoque and Hoque (2010)63 focused on the risk of obstetric complications in an adolescent population, but they did not find significant differences in the groups of young mothers studied (ages 13-15 years; 16-18 years; and 19-21 years). Finally, the

55 Studies included utilized a wide range of study populations and data was not presented in the subcategories of pregnancies, live births, pregnancies etc.
61 Bruce, F C et al., 2012. Extent of maternal morbidity in a managed care population in Georgia. Paediatric and Perinatal Epidemiology, 26, pp.497–505.
issue of access to care is included in several studies. Hoque (2011) found that women who did not have prenatal care were twice as likely to have complications. Similarly, Almerie et al. (2010) made the recommendation for improving access to antenatal care as well as improving protocols and referral systems as a key measure to lowering rates of obstetric complications.

5.2 Limitations
The process of extracting the prevalence/incidence data identified an important limitation: few studies were conducted, and their results published, with the intention to provide globally applicable data on the prevalence/incidence of obstetric complications. Most discuss a specific complication, intervention or programme and collect incidence or prevalence in response to the research question. This can lead to specific selection or combinations of study populations, resulting in bias with respect to the prevalence of obstetric complications across the whole population. Given the current focus on clinical interventions to reduce maternal mortality, many researchers are looking at single issues rather than at the big picture, which raises the question as to whether peer-reviewed literature is the correct source for incidence/prevalence data. Many studies focused on specific obstetric populations, such as obese mothers, twin gestations, grand-multiparity, or pregnancies resulting from assisted reproductive therapies, comparing cases and controls.

Additionally, the majority of studies focus exclusively on facility deliveries – even in regions/countries where the majority of births take place outside facilities. This may limit our results to women who are connected to the established health system or with the means to seek care. However, Bang et al. (2004), focusing on out-of-hospital birth, discussed the need for emergency obstetric care for those delivering at home as well as home-based postpartum care. Similarly, Rizwan et al. (2011) cited prolonged neglected obstructed labour, the need for antenatal care and (lack of) training for health workers as key social causes for uterine rupture. Hofmeyr et al. (2005) noticed greater rates of uterine rupture in less-developed countries and Ould et al. (2002) continued in that vein, when addressing elevated rates of uterine rupture, stating that even in large cities an absence of adequate facilities can be noted. Bruce et al. (2012) give evidence that in high-income countries, inequities in access continue to contribute to health outcomes, suggesting that comprehensive health insurance may lessen the risk of maternal morbidity.

5.3 Issues arising
The analyses of the retrieved articles showed no specific patterns or obvious trends, other than an increase in caesarean section rate. Despite the increased sensitivity in the iterations of the searches, few articles allowed like-for-like comparison and the subsequent drawing of conclusions. Population

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64 Hoque, M., 2011. Incidence of Obstetric and Foetal Complications during Labor and Delivery at a Community Health Centre, Midwives Obstetric Unit of Durban, South Africa. ISRN Obstetrics and Gynecology, pp.1–6.
70 Bruce, F C et al., 2012. Extent of maternal morbidity in a managed care population in Georgia. Paediatric and Perinatal Epidemiology, 26, pp.497–505.
What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.

sizes, years of study, period length for data collection, unit of measure (pregnancies, live births, deliveries) vary greatly.

Similarly, the lack of **uniformity in diagnostic criteria for the reviewed studies constitutes an important technical complication** in our review. Studies included in our analysis contained varying levels of information on diagnostic criteria for each of the obstetric complications discussed. Additionally, studies differed with regard to validation of diagnoses, as data sources varied from hospital records, interviews and self-reporting to national or regional databases. The complications themselves were not uniformly named or grouped throughout the articles. For example, hypertensive disorders of pregnancy varied greatly across the studies because some studies combined hypertensive disorders into one condition and others provided separate data on rates of pregnancy-induced hypertension/gestational hypertension, pre-eclampsia and/or eclampsia. Therefore, to allow for appropriate comparison, all hypertensive disorders were compiled into two broader variables: hypertensive disorders of pregnancy and eclampsia. Variations in how haemorrhage was presented led to the creation of a third category (obstetric haemorrhage, non-specified) to allow for the inclusion of studies that did not specify when the haemorrhage occurred. Sometimes, dystocia, prolonged and obstructed labour were grouped together despite the important difference in clinical severity between these conditions. And finally, the terms **prevalence and incidence were used interchangeably and at times inconsistently across studies**, leading to the inclusion of both prevalence and incidence data in this review.

Additionally, **certain complications were more commonly studied** than others. Based on the retrieved articles, only four articles related to complications of abortion and the same number studied ectopic pregnancy, while 28 published, peer-reviewed papers had data regarding hypertensive disorders of pregnancy. This is likely attributable to the greater incidence and prevalence of hypertensive disorders of pregnancy which, like haemorrhage, is a major cause of maternal morbidity and mortality across the globe. In contrast, obstetric interventions such as vacuum extraction, induction and/or augmentation of labour, and caesarean sections were not covered in the final list of articles reviewed. These procedures will influence the total number of interventions carried out and thus the possible caseload for the MNH workforce. Further collection and analysis of related data is required to inform the development of an appropriate benchmark that appreciates potential workload as well as skill mix.

To that end, **the exclusive consideration of published, peer-reviewed articles is unlikely to provide an accurate indication regarding the rates at which obstetric complications are occurring throughout the world and across settings.** Publications tend to evaluate limited populations in specific settings; they are rarely population-based and more commonly facility-based. There may also be a publication-bias that considers obstetric complications and interventions more readily marketable than their prevalence/incidence. Similarly, by the nature of the publication, peer-reviewed articles are generally limited in the amount of data that can be included. In further investigation of this topic, **relevant information may also be obtained through grey literature, field studies and programme analysis reports.** While such sources may not be peer-reviewed by a journal, they may have been subject to other quality and peer-review mechanisms and be appropriate to the purpose.

A final set of concerns regarding **bias within studies stemmed from the very specific research questions** presented in some of the articles. One study by Ali and Abu-Heijja (2002)\(^71\) considers a very precise case group, namely women of gravida 5 or greater with a previous caesarean section.

What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.

Roman et al. (2007)\textsuperscript{12} compare outcomes of obese and non-obese women, measuring rates of complications through matched case and control groups. Obesity is an important risk factor for several obstetric complications, and the obese group had over twice the number of cases compared to the non-obese group. Recalculating rates so that the case and control groups represent a single population raised the rate of hypertensive disorders by 60\% when compared to the non-obese group alone.

6 Conclusions
The complexity of understanding obstetric complications and their prevalence is evident from the present rapid review. Obstetric complications and their occurrence are often the result of multiple and dynamic factors such as pre-existing health, age and obstetric risk combined with key social and societal components such as life-style and habits, socio-economic status, care-seeking behaviours and access (geographic, financial, etc.) to timely and effective care. These factors lend themselves to question whether a uniform benchmark for human resource planning is possible.

Creating a universal guideline regarding the productive capacity of a health worker based on an overview of the global prevalence of obstetric complications may ignore the multiple variables that impact prevalence. The creation of a universal paradigm for appreciating obstetric complications that considers the social, regional and biophysical factors that impact obstetric complications is crucial for the development of fully functional health systems, with an appropriately equipped and located workforce who is enabled and trained to address maternal mortality and morbidity.

6.1 Next steps
There are several possible avenues that may provide further evidence to inform the benchmarking discussions. The WHO Multi-Country Survey may give some new global data, but has not yet been published. This is the largest-ever study on the prevalence of pregnancy-related complications and severe maternal outcomes using standardized definitions across 29 countries. Data are collected on more than 314'000 women, 312'000 infants born alive and 4000 stillbirths. Approximately 7\% of the population presented with potentially life-threatening conditions and about 1\% of the study population developed a severe maternal outcome (i.e. maternal death or near miss). However, the study only included hospitals with more than 1000 births per year. Whether these data can be extrapolated to show prevalence in the entire population is questionable. It is known that access, utilisation and referral to larger hospitals can be large barriers for women from poor or rural backgrounds and hence there is a high probability that their pregnancy outcomes are not represented.

EmOC assessment reports (e.g. AMDD) could be another source of information on numbers of obstetric complications. Similarly, the US Centers for Disease Control and Prevention (CDC) produce surveillance data that could contribute to the existing knowledge as do the WHO Service Availability and Readiness Assessment (SARA) reports and the Indepth network data, among others. Country-level data were collected in the Matlab studies and prevalence could also be found in the malaria studies from Mozambique. However, as these sources are not published in peer-reviewed journals they were not eligible for consideration in this review. Also excluded from this current effort are older articles, before 2002. For instance, studies reporting on caesarean sections in Britain and the USA\textsuperscript{73, 74} considered incidence of selected obstetric complications as possible determinants of rising

What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.

caesarean section rates.

In conclusion, the earlier work by Pittrof & Campbell (2000) and Ronsmans (2002) seems to be confirmed. The articles retrieved from the agreed search criteria and extraction tool for this rapid review found no research focused on the prevalence of obstetric complications. This results in a continued lack of empirical evidence to support the discussion on the occurrence of obstetric complications and the need for interventions, seriously curtailing the work on health system and human resource development in this field of medicine.

Further discussion is needed on whether and how to adjust these gaps in knowledge for the next steps in benchmark development, or whether to accept the limitations and work on top-down and bottom-up workforce planning models for a ‘typical’ district population.

7 Funding
The Instituto de Cooperación Social Integrare conducted this rapid review with funding made available by World Health Organization, Geneva.

75 Pittrof, R. & Campbell, O., 2000. Quality of Maternity Care: Silver Bullet or Red Herring?, London: London School of Hygiene & Tropical Medicine.

What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.

8 Annexes

Annex 1. Conceptual graphic of obstetric complications
What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.

Annex 2. Search strategy

- Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations and Ovid MEDLINE(R) <1946 to Present> 22/11/12

1 Obstetric Labor Complications/ep, mo (2121)
2 Pregnancy Complications/mo (1204)
3 1 or 2 (3191)
4 ((obstetric$1 or obstetrical or maternal or pregnan$) adj4 near-miss$).ti,ab. (105)
5 ((obstetric$1 or obstetrical) adj3 emergenc$ adj4 (ratio or rate or trend$1 or number$1 or frequency or estimate$1 or incidence or prevalence)).ti,ab. (29)
6 ((post-partum or postpartum or obstetric$ or emergency or peri-partum or peripartum) adj4 hysterectom$ adj4 (ratio or rate or trend$1 or number$1 or frequency or estimate$1 or incidence or prevalence)).ti,ab. (83)
7 ((admission$1 or admitted) adj4 (obstetric$1 or obstetrical or maternal) adj4 (icu or intensive care or critical care or high dependency)).ti,ab. (124)
8 (pregnan$ adj3 morbidit$ adj4 (ratio or rate or trend$1 or number$1 or frequency or estimate$1 or incidence or prevalence)).ti,ab. (33)
9 (pregnan$ adj3 complication$1 adj4 (ratio or rate or trend$1 or number$1 or frequency or estimate$1 or incidence or prevalence)).ti,ab. (519)
10 ((ante-partum or antepartum) adj3 complication$1 adj4 (ratio or rate or trend$1 or number$1 or frequency or estimate$1 or incidence or prevalence)).ti,ab. (11)
11 ((obstetric$1 or obstetrical) adj3 morbidit$ adj4 (ratio or rate or trend$1 or number$1 or frequency or estimate$1 or incidence or prevalence)).ti,ab. (14)
12 ((intra-partum or intrapartum) adj3 morbidit$ adj4 (ratio or rate or trend$1 or number$1 or frequency or estimate$1 or incidence or prevalence)).ti,ab. (3)
13 ((intra-partum or intrapartum) adj3 complication$1 adj4 (ratio or rate or trend$1 or number$1 or frequency or estimate$1 or incidence or prevalence)).ti,ab. (32)
14 ((obstetric$1 or obstetrical) adj3 complication$1 adj4 (ratio or rate or trend$1 or number$1 or frequency or estimate$1 or incidence or prevalence)).ti,ab. (248)
15 (severe maternal morbidit$ or acute maternal morbidit$ or serious maternal morbidit$).ti,ab. (233)
16 or/4-15 (1336)
17 3 or 16 (4336)
18 animals/ not humans/ (3718640)
19 (letter or editorial or case reports).pt. (2552898)
20 17 not (18 or 19) (3941)
21 limit 20 to yr="2002 -Current" (2017)
22 limit 20 to yr="1992 -Current" (2823)

- Embase via Ovid <1974 to 2012 November 21> 26/11/12

1 labor complication/ep [Epidemiology] (888)
2 maternal morbidity/ep, et [Epidemiology, Etiology] (105)
3 1 or 2 (990)
4 ((obstetric$1 or obstetrical or maternal or pregnan$) adj4 near-miss$).ti,ab. (147)
5 ((obstetric$1 or obstetrical) adj3 emergenc$ adj4 (ratio or rate or trend$1 or number$1 or frequency or estimate$1 or incidence or prevalence)).ti,ab. (46)
What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.

6 ((post-partum or postpartum or obstetric$ or emergency or peri-partum or peripartum) adj4 hysterectom$ adj4 (ratio or rate or trend$1 or number$1 or frequency or estimate$1 or incidence or prevalence)).ti,ab. (111)
7 ((admission$1 or admitted) adj4 (obstetric$1 or obstetrical or maternal) adj4 (icu or intensive care or critical care or high dependency)).ti,ab. (192)
8 (pregnan$ adj3 morbidity$ adj4 (ratio or rate or trend$1 or number$1 or frequency or estimate$1 or incidence or prevalence)).ti,ab. (38)
9 (pregnan$ adj3 complication$1 adj4 (ratio or rate or trend$1 or number$1 or frequency or estimate$1 or incidence or prevalence)).ti,ab. (694)
10 ((ante-partum or antepartum) adj3 complication$1 adj4 (ratio or rate or trend$1 or number$1 or frequency or estimate$1 or incidence or prevalence)).ti,ab. (10)
11 ((obstetric$1 or obstetrical) adj3 morbidity$ adj4 (ratio or rate or trend$1 or number$1 or frequency or estimate$1 or incidence or prevalence)).ti,ab. (20)
12 ((intra-partum or intrapartum) adj3 morbidity$ adj4 (ratio or rate or trend$1 or number$1 or frequency or estimate$1 or incidence or prevalence)).ti,ab. (4)
13 ((intra-partum or intrapartum) adj3 complication$1 adj4 (ratio or rate or trend$1 or number$1 or frequency or estimate$1 or incidence or prevalence)).ti,ab. (36)
14 ((obstetric$1 or obstetrical) adj3 complication$1 adj4 (ratio or rate or trend$1 or number$1 or frequency or estimate$1 or incidence or prevalence)).ti,ab. (354)
15 (severe maternal morbidity$ or acute maternal morbidity$ or serious maternal morbidity$).ti,ab. (325)
16 or/4-15 (1832)
17 3 or 16 (2749)
18 (animal/ or nonhuman/) not human/ (4533005)
19 case report/ (1905984)
20 (letter or editorial).pt. (1225595)
21 17 not (18 or 19 or 20) (2579)
22 limit 21 to yr="2002 -Current" (1527)

- LILACS via iAH form [http://bases.bireme.br/cgi-bin/wxislind.exe/iah/online/?IsisScript=iah/iah.xis&base=LILACS&lang=i&form=A 27/11/12](http://bases.bireme.br/cgi-bin/wxislind.exe/iah/online/?IsisScript=iah/iah.xis&base=LILACS&lang=i&form=A)

Note: Due to the failure of the export option in the Virtual Health Library interface, these searches were run using the iAH form. This interface has limited functionality which impacted on the adaption of the search.

Due to the difficulty limiting the search by date, records from all years were downloaded into EndNote. Here, the pre-2002 records were removed and the remainder saved as RIS files for the client.

(TW obstetric$ OR TW materna$ OR TW pregnan$ OR TW embaraz$ OR TW gravide$ OR MH pregnancy) AND (TW near AND TW miss$) 23

(TW obstetric$ OR TW materna$ OR TW pregnan$ OR TW embaraz$ OR TW gravide$ OR MH pregnancy) AND (TW emergenc$ OR TW urgencias medicas OR MH emergencies) AND (TW ratio OR TW rate OR TW trend$ OR TW number OR TW frequency OR TW estimate OR TW incidence OR TW prevalence OR MH incidence OR MH prevalence) 57

(TW post-partum OR TW postpartum OR TW obstetric$ OR TW emergenc$ OR TW peri-parum OR TW peripartum) AND (TW hysterectom$ OR MH hysterectomy OR TW hysterectom$) AND (TW ratio OR
What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.

TW rate OR TW trend$ OR TW number OR TW frequency OR TW estimate OR TW incidence OR TW prevalence OR MH incidence OR MH prevalence) 34

(TW admission$ OR TW admitted OR TW admitido OR TW admision$ OR TW admissoes OR TW admission) AND (TW "intensive care" OR TW ICU OR TW "critical care" OR TW "high dependancy" OR MH intensive care OR MH intensive care unit OR TW "cuidados intensivos" OR TW "Terapia Intensiva") OR (TW obstetric$ OR TW materna$) 20

(TW pregnant$ OR TW embaraz$ OR TW gravida$) AND (TW morbidit$ OR TW morbilidad OR TW morbidade) AND (TW ratio OR TW rate OR TW trend$ OR TW number OR TW frequency OR TW estimate OR TW incidence OR TW prevalence OR MH incidence OR MH prevalence) 354

(TW ante-partum OR TW antepartum) AND complication$1 AND (TW ratio OR TW rate OR TW trend$ OR TW number OR TW frequency OR TW estimate OR TW incidence OR TW prevalence OR MH incidence OR MH prevalence) 10

(TW obstetric$) AND (TW morbidit$ OR TW morbilidad OR TW morbidade) AND (TW ratio OR TW rate OR TW trend$ OR TW number OR TW frequency OR TW estimate OR TW incidence OR TW prevalence OR MH incidence OR MH prevalence) 32

(TW intrapartum OR TW intra-partum) AND (TW morbidit$ OR TW morbilidad OR TW morbidade) AND (TW ratio OR TW rate OR TW trend$ OR TW number OR TW frequency OR TW estimate OR TW incidence OR TW prevalence OR MH incidence OR MH prevalence) 4

(TW intrapartum OR TW intra-partum) AND (TW complication$) AND (TW ratio OR TW rate OR TW trend$ OR TW number OR TW frequency OR TW estimate OR TW incidence OR TW prevalence OR MH incidence OR MH prevalence) 14

(TW obstetric$) AND TW complication$ AND (TW ratio OR TW rate OR TW trend$ OR TW number OR TW frequency OR TW estimate OR TW incidence OR TW prevalence OR MH incidence OR MH prevalence) 310

TW “severe maternal morbidity” OR TW “acute maternal morbidity” OR TW “serious maternal morbidity” 14

Search process
The original search was designed to retrieve papers on rates of complications, causes of mortality, and rates of interventions. No date, geographical, language or sample size limits were applied. This very broad search retrieved too many results to be manageable and so it was necessary to revise the scope of the search and increase the precision of the strategy. Adaptions were tested against published, relevant systematic reviews to test that sensitivity was preserved (Tunclap et al. 2012 and Minkauskiene et al. 2004). Sample results were reviewed in order to identify any further refinements. Key changes to the initial strategy include:

• Removing searches related to outcomes for the infant such as premature birth or stillbirth.
• Removing searches for specific obstetric complications. These search lines retrieved a large number of irrelevant results. An analysis of relevant records showed that restricting the search to the more generic terms did not have a significant impact on sensitivity, but did greatly increase precision.
What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.

- Removing searches for rates of maternal mortality as a large number of these studies did not provide the required data on causation. It was accepted that this may result in some potentially relevant studies reporting maternal death by cause being missed.
- The addition of searches to capture rates of emergency hysterectomy and obstetric ICU admission as indicators of obstetric complication. Rates of caesarean section was not searched for specifically as there is a large volume of literature associated with this topic, much of it concerned with elective or non-maternally indicated procedures.
- Restricting the subject heading searches to the two headings found most frequently in relevant studies. PUBReMiner was also employed to confirm the suitability of these index terms. Although the subject heading searches bring back a large number of false positives, it was decided not to remove them. The variability of language in the title and abstracts of relevant papers meant that relying on keyword searches would result in an unacceptable loss of sensitivity.
- Introducing a date limit of 2002 to current.

The search was restricted to three electronic databases. These were selected based on the findings of a 2004 World Health Organization systematic review of maternal mortality and morbidity. The paper they published discussing the utility of information resources in this topic area identified MEDLINE and EMBASE as essential sources as they retrieved the largest volume of unique references (Betran et al. 2005). LILACS was the source of the third largest number of unique references and provided valuable information from journals published outside of Western Europe and the USA.

The MEDLINE searches were adapted for the other search resources. In LILACS, key terms were translated into Spanish and Portuguese and added to the search.
What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.

Annex 3. Extraction tool

Screening
1. Does the report refer to incidence/prevalence rates of obstetric complications?
2. Is the methodology of the study described?
3. Does the report specify dates for data collection?
4. Is the number of study participants more than 500?

Section A: General Characteristics of the Study
5. What is the study country?
6. What is the type of study? (census, cross-sectional, cohort/longitudinal, controlled trial, incidence/prevalence survey)
7. What is the sampling method? (random sample, non-random sample, total population)
8. What is the source of the data? (vital statistics/census, medical records, special survey/interview, multiple sources, clinical data collected for study)
9. What is the sample size?
10. What is the evaluated population?
   10.1. Urban/rural/mixed?
   10.2. Are the characteristics of the population described? (socio-economic status, ethnic group, age group, etc.)
   10.3. Are the health characteristics of the population described? (healthy women, women with a specific condition, etc.)
11. Is there information about eligible/lost subjects and their characteristics?
12. What is the place studied? (national, province/region, city, medical facility, etc.)
13. What is the place of delivery/abortion? (home, hospital, mixed, unknown, n/a, etc.)

Section B: Prevalence/Incidence of Obstetric Complications/Maternal Morbidity
14. Which conditions are investigated?
15. What are the diagnostic criteria?
16. How many cases are recorded per condition?
17. What is the prevalence/incidence of the conditions investigated?
18. Are background causes of the complications examined?

Section C: Quality Assessment of Morbidity Reports
19. Are all concepts and conditions clearly defined?
20. Is the diagnostic procedure described?
What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.

Annex 4. Extraction process

Screening strategy

The databases EMBASE, LILACS and MEDLINE were searched using the developed search strategy. Number of articles found was 2017 for MEDLINE, 1527 for EMBASE and 872 for LILACS. Screening out of duplicates using Mendeley rendered 3160 original articles for revision. These articles were organized into subsets based on the search terms that obtained them. This allowed for prioritization of the most relevant article sets for a more exhaustive review process. High-priority sets (search terms: obstetric complications or morbidity) were screened through a detailed abstract review, whereas low-priority sets (all related search terms) were screened through a title review and abstract review where necessary.

Screening consisted of four essential questions:

1. Does the report refer to incidence/prevalence rates of obstetric complications within a normal population?
2. Is the methodology of the study described?
3. Does the report specify dates for data collection?
4. Is the number of study participants greater than 500?

A total of 324 articles were selected as having passed the screening process. Given time constraints, a second screening was performed on these articles to identify those with a high relevance to the purpose of the review, that is, those with reference to any of the following obstetric complications, as defined by UNFPA/WHO/UNICEF:

- Haemorrhage (antepartum or postpartum);
- Prolonged or obstructed labour;
- Postpartum sepsis;
- Complications of abortion;
- Pre-eclampsia/eclampsia;
- Ectopic pregnancy;
- Ruptured uterus.

A total of 60 articles were obtained from this secondary screening process.

What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.

Annex 5. Summary characteristics of studies

<table>
<thead>
<tr>
<th>Title</th>
<th>Author(s)</th>
<th>Publication</th>
<th>Year</th>
<th>Description</th>
<th>Study Country</th>
<th>Type of Study</th>
<th>Sampling Method</th>
<th>Data Source</th>
<th>Sample Size</th>
<th>Eligible subjects</th>
<th>Relevant complications investigated and diagnostic criteria given</th>
<th>Findings</th>
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<tbody>
<tr>
<td>Impact of grandmultiparity on obstetric outcome in low resource setting.</td>
<td>Agarwal, S., Agarwal, A. &amp; Das, V.,</td>
<td>The Journal of Obstetrics and Gynaecology research</td>
<td>2011</td>
<td>To evaluate the impact of grandmultiparity on obstetric outcome in a low resource setting, this study compared 282 antenatal grandmultiparous women (parity ≥4) with consecutive 564 antenatal women with parity 1–3.</td>
<td>India</td>
<td>Retrospective case control study</td>
<td>Antenatal women with parity 1-3 used as control group</td>
<td>Hospital records</td>
<td>564 women</td>
<td>Parity 1-3</td>
<td>Pregnancy induced hypertension; eclampsia; obstructed labour; ruptured uterus</td>
<td>There were 13,403 deliveries over the study period. The prevalence of grandmultipara was 2.5%. Grandmultipara were older (P &lt; 0.001) and more commonly from rural areas (P &lt; 0.001) as compared to the control group. The percentage of Muslim among grandmultipara (23.8%) was higher than among controls (16.5%). P &lt; 0.01. Grandmultipara had significantly higher prevalence of anaemia (P &lt; 0.001), malpresentation (P &lt; 0.01) and rupture uterus (P &lt; 0.001). Abruptio placentae, placenta previa and obstructed labour were seen more often in grandmultipara, and the difference was statistically significant (P &lt; 0.01 in each group). There was no difference in terms of mode of delivery, sex of newborn or the prevalence of low birthweight (&lt;2.5 kg) babies. Stillbirths were more common in grandmultipara (P &lt; 0.001).</td>
</tr>
<tr>
<td>Grandmultiparity and pregnancy outcome in Abu, Nigeria: a case-control study.</td>
<td>Akwuruoha, E. et al.</td>
<td>Archives of Gynecology and Obstetrics</td>
<td>2011</td>
<td>This study compared the incidence of antenatal and intrapartum complications and perinatal outcomes among women who had delivered five or more times (grandmultiparous) with those of age-matched controls who had delivered two to four times (multiparous).</td>
<td>Nigeria</td>
<td>Case-control</td>
<td>Age-matching to grand-multiparous women</td>
<td>Maternal case records</td>
<td>734 women</td>
<td>Primigravidae excluded</td>
<td>Pregnancy-induced hypertension: defined as blood pressure measurement of ≥140 mmHg systolic or higher and/or ≥90 mmHg diastolic or higher on two occasions at least 6 h apart; prolonged labour; obstructed labour; puerperal sepsis; uterine rupture; primary postpartum haemorrhage: defined as the loss of 500 ml of blood or more within 24 h of delivery, using visual estimation which was correlated with clinical presentation. Study shows that there is an increased risk of antenatal anaemia, multiple pregnancy, primary postpartum haemorrhage, and adverse perinatal outcomes in grandmultiparous women independent of maternal age.</td>
<td></td>
</tr>
<tr>
<td>Pre-eclampsia: maternal risk factors and perinatal outcome.</td>
<td>Al-Muhtem, A.A et al.</td>
<td>Fetal Diagnosis and Therapy</td>
<td>2003</td>
<td>The aim of this study was to throw light on the incidence of pre-eclampsia (PE) in women attending for care and delivery at a hospital in Saudi Arabia, and analyse the maternal risk factors and outcome of mothers and neonates in pregnancies complicated by PE. This retrospective study involved almost all women (n = 27,787) who delivered at King Fahad Hospital of the University in a 10-year period (1992-2003).</td>
<td>Saudi Arabia</td>
<td>Retrospective study</td>
<td>Women delivering in the hospital during the study period</td>
<td>Hospital records</td>
<td>27,787 maternities</td>
<td>Not described</td>
<td>Severe hypertension: diastolic blood pressure measurement of ≥120 mm Hg on one occasion, or ≥110 mm Hg on 2 occasions, 4 hours apart.</td>
<td>Study documents a hospital-based incidence rate of PE of 2.47%, with a high proportion of PE cases occurring among nulliparous women and those at the extreme ends of the reproductive age. More maternal and neonatal complications were encountered in women with PE when the PE was severe, when the pregnancy had to be terminated early, when there was no regular antenatal care, the birth weight was low, or the proteinuria was severe.</td>
</tr>
<tr>
<td>High incidence of obstetric complications in Kasala Hospital, Eastern Sudan.</td>
<td>Aji, A. A. et al.</td>
<td>Journal of Obstetrics and Gynaecology</td>
<td>2012</td>
<td>Retrospective review of the medical files of women delivered at Kasala Hospital, Eastern Sudan in the period of January-December 2009.</td>
<td>Sudan</td>
<td>Retrospective chart review (descriptive analysis)</td>
<td>All deliveries</td>
<td>Hospital records</td>
<td>4689 deliveries</td>
<td>All deliveries</td>
<td>Pre-eclampsia; eclampsia; AHP; PHH; obstructed labour; ruptured uterus.</td>
<td>Out of 4,689 delivered women, 14.7% were teenagers, 67.1% had no antenatal care and 12.6% were grandmultiparous. Obstetric complications included: pre-term birth (2.6%); pre-eclampsia/eclampsia (4.2%); haemorrhage (2.9%); malpresentation (5.5%); obstructed labour (1.9%) and ruptured uterus (0.6%). Caesarean delivery rate was 31.1%. While 89.4% of the newborn babies were taken home, 6% were admitted to the nursery. 4.4% were stillbirths, and 0.2% immediate neo-natal deaths. There were 26 maternal deaths (550 per 100,000 live births), mainly due to septicaemia (38.4%), haemorrhage (19.2%), embolism (15.3%) and malaria (11.5%). Thus, there is a high frequency of maternal morbidities and mortality which needs improvement in obstetric care.</td>
</tr>
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</table>

February 2013 31
What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.

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<td>Obstetric and perinatal outcome of women para &gt; or = 5 including one lower segment cesarean section.</td>
<td>Ali, A.M. &amp; Abu-Habib, A.T.</td>
<td>The Journal of Obstetrics and Gynaecology Research</td>
<td>2002</td>
<td>The aim of this study was to investigate the prevalence of antenatal, intrapartum and postpartum complications and their perinatal outcome in women who have and are delivering for the 6th time and have also had one cesarean section.</td>
<td>Saudi Arabia</td>
<td>Retrospective case-control study</td>
<td>All women delivering at hospital, cases are those with 5 or more deliveries and a previous caesarean section, control all others except those with 2 caesarean sections (only planned vaginal deliveries)</td>
<td>Hospital records</td>
<td>2708 cases and controls</td>
<td>Control group includes those with previous c-sections, case group is only those with at least 5 deliveries (and 1 C/S). No planned C/S are included.</td>
<td>Uterine scar dehiscence and/or rupture.</td>
<td>The incidence of malpresentation was higher in the study group. The incidence of uterine rupture and uterine scar dehiscence was significantly higher in the study group, but there was no perinatal or maternal death associated with this and in all cases the uterus was preserved. More women managed to deliver vaginally after the cesarean section in the grandmultiparous women compared with the women in the control group (81.5% vs 63.0%) P &lt; 0.0006, where the cesarean section rate was significantly higher (P &lt; 0.02). There were no significant differences in the incidences of preterm labor, lethal malformations, stillbirths and neonatal deaths in the two groups of women. There was one case of cesarean hysterectomy in each group due to placenta accreta and acute postpartum hemorrhage, and one maternal death in the control group.</td>
</tr>
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<td>Obstetric near-miss and maternal mortality in maternity university hospital, Damascus, Syria: a retrospective study</td>
<td>Almerie, Y. et al.</td>
<td>BMC Pregnancy and Childbirth</td>
<td>2010</td>
<td>The aim of this study is to document the frequency and nature of maternal near-miss at hospital level in Damascus, Capital of Syria; and to evaluate the level of care at maternal life-saving emergency services by comparatively analyzing near-misses and maternal mortalities. A retrospective facility-based review of cases of near-miss and maternal mortality that took place in the years 2006-2007 at Damascus Maternity University Hospital, Syria was conducted.</td>
<td>Syria</td>
<td>Retrospective study</td>
<td>All admissions to maternity hospital in 2006-07</td>
<td>Hospital records</td>
<td>28 025 deliveries or 27 350 live births</td>
<td>All women giving birth at the facility during the study period.</td>
<td>Severe haemorrhage (leading to shock, emergency hysterectomy, coagulation defects and/or blood transfusion of ≥ 2 litres), hypertensive disorders in pregnancy which include eclampsia, severe pre-eclampsia (BP ≥ 140/90 mmHg and proteinuria &gt; 1g/24hrs) or HELLP syndrome, pyrexia or fever (body temperature &lt; 36°C or &gt; 36°C) and clinical signs of shock (systolic BP &lt;90 mmHg and heart rate &gt; 120 beats per minute); dysuria which includes uterine rupture and impending rupture; Prolonged labour: labour duration greater than 24 hours from the onset of mild pain to the birth of baby; Primary postpartum haemorrhage (PPH): Excessive bleeding on first day and mother hypothermic (&lt;35°C) or unconscious; Puerperal infection of genital tract: Foul smelling vaginal discharge and fever; and/or b) small vaginal discharge and secondary PPH; The incidence of maternal morbidity was 52.6%, 17.1% during labour and 42.9% during puerperium. The most common intrauterine morbidities were prolonged labour (30.3%), prolonged rupture of membranes (5.7%), abnormal presentation (4.0%) and primary postpartum haemorrhage (3.3%). The postpartum morbidities included breast problems (18.4%), secondary postpartum haemorrhage (15.2%), puerperal genital infections (10.2%) and thrombosis (7.4%). Abnormal presentation and some puerperal complications (infection, fits, psychosis and breast problems) were significantly associated with adverse perinatal outcomes, but prolonged labour was not. A third of the mothers were in need of medical attention: 15.1% required emergency obstetric care and 24.0% required non-emergency medical attention. There were 159,896 mothers delivered of whom 313 (2.0/1000) had 385 markers of severe morbidity (307 had one, 42 had two, 12 had three, and two had four). The following rates of morbidity were recorded: blood transfusion 55 units (0.74/1000); emergency hysterectomy 88 (0.55/1000); uterine rupture 49 (0.31/1000); eclampsia 46 (0.36/1000); ICU 83 (0.52/1000). There was a statistically significant association between multiparity ≥ 3, and emergency hysterectomy and uterine rupture; between age ≥ 35 years, and emergency hysterectomy, uterine rupture and ICU; and between caesarean delivery and blood transfusion ≥5 units, emergency hysterectomy, uterine rupture, eclampsia and ICU. The main contributing obstetric complications were haemorrhage (94.7%) and complications of hypertensive disorders (16.8%).</td>
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<td>Maternal mortality during labour and the puerperium in rural India and the need for medical attention: A prospective observational study in Gadchiroli, India</td>
<td>Bergt, R. A. et al.</td>
<td>BMC Pregnancy and Childbirth</td>
<td>2004</td>
<td>This prospective observational study aimed to estimate the incidence of maternal mortality during labour and the puerperium in rural India; the association with perinatal outcome; and the proportion of women needing medical attention. Thirty-nine villages in the Gadchiroli district, Maharashtra, India, were surveyed, with 772 women delivering over a six-month period (May 1995-1996) and followed up from the seventh month in pregnancy to 28 days postpartum (up to 35 visits in total).</td>
<td>India</td>
<td>Observational study</td>
<td>All women delivering in 19 study villages</td>
<td>Observation by village health worker, validated by physician.</td>
<td>772 pregnancies</td>
<td>All deliveries</td>
<td>Severe haemorrhage was the leading cause of maternal mortality (60%) while sepsis had the highest mortality index (7.4%).</td>
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<td>Severe obstetric morbidity a 15-year population-based study.</td>
<td>Baskett, T.F. &amp; O’Connell, C.M.</td>
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<td>This study chose five markers of maternal morbidity: blood transfusion ≥5 units, emergency hysterectomy, complete uterine rupture, eclampsia, and the need for intensive care (ICU) that are considered to cover the main complications threatening maternal health including: haemorrhage and disseminated intravascular coagulation; complications of hypertensive disorders, including pulmonary oedema, coma, renal dysfunction; sepsis; and other major medical disorders that require intensive care. In this population-based study these markers of maternal morbidity were assessed and related to age, parity and method of delivery. The primary obstetric complication leading to the morbidity was ascertained.</td>
<td>Canada</td>
<td>Retrospective study</td>
<td>All deliveries &lt;500g in Nova Scotia hospitals, 1998-2003</td>
<td>Perinatal database</td>
<td>151986 deliveries</td>
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<td>Overview of maternal morbidity during hospitalization for labor and delivery in the United States: 1993-1997 and 2001-2005.</td>
<td>Berg, C. I. et al.</td>
<td>Obstetrics and Gynecology</td>
<td>2009</td>
<td>This study assesses progress toward meeting the U.S. Healthy People 2010 objective of reducing the rate of maternal mortality at delivery hospitalization by comparing National Hospital Discharge Survey data from two time periods. Rates of intrapartum morbidity defined by obstetric complications, preexisting medical conditions, and cesarean delivery during 2001-2005 are compared with rates published for 1993-1997.</td>
<td>United States</td>
<td>Retrospective cohort study</td>
<td>Data from National Hospital Discharge Survey, which, with application of appropriate sampling weights, represents all hospitals in the US.</td>
<td>National Hospital Discharge Survey</td>
<td>39,067 deliveries</td>
<td>Excludes all deliveries associated with hydramnion mele, ectopic pregnancy, spontaneous or induced abortion</td>
<td>APH; PPH; pre-eclampsia and eclampsia; uterine rupture; sepsis - all defined according to International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) criteria.</td>
<td>Between 1993-1997 and 2001-2005, the rate of obstetric complications remained unchanged at 28.6%; the prevalence of preexisting medical conditions at delivery decreased from 4.2% to 3%. Rates of chronic hypertension and pre eclampsia, gestational and preexisting diabetes, asthma, and postpartum haemorrhage increased, whereas rates of third- and fourth-degree lacerations and various types of infection decreased. The caesarean delivery rate increased from 21.8% to 28.3%.</td>
</tr>
<tr>
<td>Endometriosis is associated with a decreased risk of pre-eclampsia.</td>
<td>Brosens, I. A., et al.</td>
<td>Human Reproduction</td>
<td>2007</td>
<td>This retrospective case-control study, set at the University of Ghent I/F centre, compared the incidence of pre-eclampsia and pregnancy-induced hypertension (PIH) following the clinical and/or laparoscopic diagnosis of endometriosis-associated infertility with the incidence of these obstetric complications in pregnancies following treatment for male-factor infertility. Pregnancy data were obtained by searching electronic databases and postal questionnaires. The case and control groups were matched for age, parity and multiple pregnancies.</td>
<td>Belgium</td>
<td>Retrospective case-control study</td>
<td>Patients in fertility clinic for endometriosis associated infertility. Male factor infertility used as a control group.</td>
<td>Medical database and postal questionnaires</td>
<td>519 deliveries</td>
<td>Excludes multiple cause infertility.</td>
<td>PIH: persistently raised blood pressure (&gt;140/90 mmHg) starting after the 12th week of gestation in an otherwise normotensive woman; Pre-eclampsia: PIH with proteinuria (&gt;300 mg/24 h).</td>
<td>The incidence of pre-eclampsia was significantly lower in the control group (0.8%) when compared with control group (5.8%). Analysis of obstetric outcome in the subgroup of patients with laparoscopic data confirmed the lower risk of pre-eclampsia in the case (1.2%) versus control (7.4%) groups. PIH occurred in 3.9% and 8.7% of case and control pregnancies, respectively. The odds of developing pre-eclampsia were 5.67 times higher in the control group than in pregnancies following endometriosis-associated infertility. In multiple pregnancies, the odds of developing pre-eclampsia increased 1.93 times per additional child, with or without endometriosis.</td>
</tr>
<tr>
<td>Extent of maternal morbidity in a managed care population in Georgia</td>
<td>Bruce, F. C. et al.</td>
<td>Paediatric and Perinatal Epidemiology</td>
<td>2012</td>
<td>To obtain an accurate assessment of maternal morbidity, this study applied a validated computerized algorithm to identify pregnancies and pregnancy-related complications in a defined population enrolled in a health maintenance organization in the south-eastern United States. Most common morbidities were examined by pregnancy outcome and maternal characteristics.</td>
<td>United States</td>
<td>Retrospective study</td>
<td>Data from Health Management Organization searched for pregnancy related complications using a computerized algorithm.</td>
<td>Health Management Organization (HMO) database</td>
<td>37,741 pregnancies</td>
<td>Excludes pregnancies that ended in a livebirth and stillbirth.</td>
<td>Pregnancy-induced hypertension; APH defined according to ICD-9-CM criteria.</td>
<td>The study identified 37 743 pregnancies; in half (52.0%), at least one complication occurred. The five most common were urinary tract infections, anaemia, mental health conditions, pelvic and perineal complications, and obstetrical infections. Complications were more likely in women with low socio-economic status (SES), and among non-Hispanic black women compared with non-Hispanic white women. Multivariable models stratified by race/ethnicity indicated that in pregnancies among non-Hispanic white women, low SES had a modest effect on the odds of having preexisting medical conditions (adjusted odds ratio [AOR] 1.3 [95% confidence interval (CI) 1.2, 1.5]) or having any morbidity (AOR 1.3 [95% CI 1.2, 1.4]). Low SES had little effect on complications among non-Hispanic Black women.</td>
</tr>
<tr>
<td>Maternal morbidity rates in a managed care population.</td>
<td>Bruce, F. C. et al.</td>
<td>Obstetrics and Gynecology</td>
<td>2008</td>
<td>This study aimed to identify and estimate prevalence rates of maternal morbidities by pregnancy outcome and selected covariates during the antepartum, intrapartum, and postpartum periods in a defined population of pregnant women. Electronic data systems of a large, vertically integrated, group-model health maintenance organization (HMO) were used to develop an algorithm that searched International Classification of Diseases, 9th Revision, Clinical Modification, codes for 38 predetermined groups of pregnancy-related complications among women enrolled of this HMO between January 1, 1998, and December 31, 2001.</td>
<td>United States</td>
<td>Retrospective study</td>
<td>Data from Health Management Organization searched for pregnancy related complications using a computerized algorithm.</td>
<td>Health Management Organization (HMO) database</td>
<td>24,481 pregnancies</td>
<td>Females aged 12-55 years, whose pregnancy episode occurred completely within the study period (1998-2002) and who were still members of the HMO at the date of the pregnancy outcome.</td>
<td>APH; PPH; uterine rupture; hypertensive disorders of pregnancy - all defined according to ICD-9-CM criteria.</td>
<td>Study identified 24,483 pregnancies among 21,011 women. Although prevalence and type of morbidity varied by pregnancy outcome, overall, 50% of women had at least one complication. The most common complications were anaemia (9.3%), urinary tract infections (9.2%), mental health conditions (9.0%), hypertensive disorders (8.5%), and pelvic and perineal trauma (7.0%). The most common complications we found usually do not require hospitalisation so would be missed in studies that use only hospitalization data.</td>
</tr>
</tbody>
</table>
### Severe maternal abdominal complications associated with the occurrence of abortion in Brazil

**Objective of the study:**
To evaluate the reported occurrence of spontaneous and induced abortion, and abortion-associated severe maternal morbidity in Brazil. A secondary analysis of the 2005 Brazilian Demographic Health Survey was conducted. Data on women's experience of spontaneous/induced abortion and associated factors were analyzed overall and by geographic region.

**Data Source:**
Demographic Health Survey

**Sample:**
5500 pregnant women and 63,870 women

**Eligible subjects:**
Some losses to follow-up, mainly from refusal to participate

**Findings:**
Abortion significantly increased the risk of complications (haemorrhage and infection). CONCLUSION: Spontaneous abortion was significantly associated with parity and maternal age. Abortion in general carried a higher risk of severe maternal complications.

### Reduction in the occurrence of uterine rupture in Central India

**Objective of the study:**
To evaluate the occurrence of uterine rupture in Central India, between 1989 and 2000.

**Data Source:**
Central India

**Sample:**
All deliveries

**Eligible subjects:**
Complete uterine rupture: all the layers of uterine wall had given way.

**Findings:**
The incidence of rupture of the pregnant uterus was 0.62 per 1000 births. No teenager or elderly woman (over 40) or grandmultipara sustained a uterine rupture. Four women had a rupture of a previous scar. In five rupture had occurred in association with malpresentations, one was a case of hydrocephalus, two had a morbidly adherent placenta praevia and four had a normal presentation, with lack of progress in labour. Perinatal mortality was 77.77% compared to 5.48% maternal and 100% perinatal mortality in the cases reported previously between 83 and 88, from the same institution. Overall, there is some improvement in perinatal survival and one-quarter incidence of rupture of the pregnant uterus.

### Pregnancy complications by overweight and residential area. A prospective study of an urban Norwegian cohort

**Objective of the study:**
This prospective cohort study compares risks of pregnancy complications in Oslo according to prevalence of overweight and areas of residence.

**Data Source:**
Norway

**Sample:**
3677 deliveries

**Eligible subjects:**
Pre-eclampsia: Pregnancy-induced hypertension and proteinuria (pregnancy-induced hypertension required blood pressure ≥140/90 mmHg or an increase in diastolic pressure of ≥15 mmHg compared with average measurements before 20 weeks' gestation, measured twice at least 6 h apart; proteinuria was defined as 2+ on a dipstick [100mg/24h] or at least twice with an interval of 24 h); Gestational hypertension: pregnancy-induced hypertension without proteinuria.

**Findings:**
Increasing age was significantly associated with miscarriage, chromosomal abnormalities, congenital anomalies, gestational diabetes, placenta previa, and caesarean delivery. Patients aged 35–39 years were at an increased risk for macrosomia. Increased risk for abortion, preterm delivery, low birth weight, and perinatal mortality was noted in women aged 40 years and older.
What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.

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<tr>
<td>Magnitude of maternal morbidity during labor and delivery: United States, 1993–1997.</td>
<td>Fronczak, N., et al.</td>
<td>American Journal of Public Health</td>
<td>2003</td>
<td>This study sought to determine the prevalence of maternal morbidity during labour and delivery in the United States. Analyses focused on National Hospital Discharge Survey data available for women giving birth between 1993 and 1997.</td>
<td>United States</td>
<td>Descriptive analysis</td>
<td>All hospitalizations for delivery included in the National Hospital Discharge Survey</td>
<td>National Hospital Discharge Survey</td>
<td>154,001 records representing 20,061,018 deliveries</td>
<td>All deliveries</td>
<td>Pre-eclampsia; Eclampsia; APH (placenta previas); APH (other)</td>
<td>The prevalence of specific types of maternal morbidity was low, but the burden of overall morbidity was high. 43% of women experienced some type of morbidity during their delivery/hospitalization. 19% (0.2 million women) had at least 1 obstetric complication or at least 1 preexisting medical condition.</td>
</tr>
<tr>
<td>Fetal gender and gestational-age-related incidence of pre-eclampsia.</td>
<td>Elenen, E. et al.</td>
<td>Acta Obstetricia et Gynecologica Scandinavica</td>
<td>2006</td>
<td>The objective of this population-based study was to investigate whether the fetal and newborn gender is associated with the incidence of antenatal maternal pregnancy complications, and to investigate if gender-associated risk changes with gestational age at delivery.</td>
<td>Sweden</td>
<td>Retrospective population-based study</td>
<td>All newborns registered in the Medical Birth Register (MBR) during a 12-year period: January 1, 1990 to December 31, 2001.</td>
<td>National Birth database.</td>
<td>118,276 deliveries</td>
<td>Included: live born infants of all gestations, and stillborn infants ≤28 weeks gestation. Singleton as well as multiple pregnancies were included.</td>
<td>Pre-eclampsia: pregnancy-specific syndrome observed after the 20th week of pregnancy with systolic blood pressure ≥140 mmHg and/or diastolic blood pressure of ≥90 mmHg accompanied by significant proteinuria (≥0.3 g protein in a 24-h specimen).</td>
<td>When all gestational ages were evaluated, male newborn gender was associated with increased odds ratios for all five diagnosis groups, and for preterm birth before 37 weeks gestation. In very preterm births (gestational age below 32 weeks), male newborn gender associated with a significantly lower risk for pre-eclampsia, and a marginally lower risk for polyhydramnios. The finding could be due to an increased risk for spontaneous abortions in pregnancies with male fetuses, but could also be associated with the etiology of these conditions.</td>
</tr>
<tr>
<td>Delivery related complications and early postpartum morbidity: Dhaka, Bangladesh</td>
<td>Fronczak, N., et al.</td>
<td>International Journal of Gynaecology and Obstetrics</td>
<td>2005</td>
<td>The objective of this study was to describe delivery-related complications and postpartum morbidity of women living in slum areas of Dhaka, Bangladesh. From November 1993 to May 1995, 1,506 women were interviewed regarding delivery-related complications and postpartum morbidities.</td>
<td>Bangladesh</td>
<td>Prospective community-based study</td>
<td>Multi-stage probability methodology used for selection of women.</td>
<td>Interviews</td>
<td>1,506 deliveries</td>
<td>Eligibility: women living in slums, completed at least 7 months of pregnancy, planning to give birth in Dhaka.</td>
<td>Severe anteprtum bleeding: Intrapartum bleeding; Hypertensive disorders; Pre-eclampsia; Eclampsia; Prolonged labor (&gt;18 hours and 66 hours).</td>
<td>Thirty-six percent of women described serious delivery-related complications and 75% of women reported postpartum morbidity. There were two maternal deaths among 1471 live births. When maternal reports were related to corroborating information, the proportion of women’s reports of various complications and morbidity appears reasonably accurate for some conditions.</td>
</tr>
<tr>
<td>Safety of low-molecular-weight heparin during pregnancy: a retrospective controlled cohort study.</td>
<td>Galambos, P.J. et al.</td>
<td>European Journal of Obstetrics, Gynecology, and Reproductive Biology</td>
<td>2012</td>
<td>Comparison of 648 pregnancies exposed to low-molecular-weight heparin (LMWH) treatment during pregnancy for the mother and the fetus with 639 unexposed pregnancies. Principal characteristics, indications for LMWH use, and maternal and fetal complications were reported for each pregnancy.</td>
<td>Finland</td>
<td>Retrospective controlled cohort study</td>
<td>Control group for women treated with LMWH matched for age and delivery route</td>
<td>Hospital records</td>
<td>626 pregnancies</td>
<td>Singleton pregnancies only</td>
<td>Antenatal Bleeding; Pre-eclampsia: systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg and proteinuria ≥0.5 g/day</td>
<td>The incidence rates of various pregnancy complications did not differ between the groups (LMWH group vs control group): 1.56% vs 1.1% for thrombocytopenia, 8.7% vs 0.5% for premature delivery, 0.7% vs 0.2% for stillbirth, 1.4% vs 1.0% for severe pre-eclampsia, 2.7% vs 2.2% for foetal growth restriction, and 10.7% vs 7.8% for antenatal bleeding. One serious antenatal maternal haemorrhage occurred in the LMWH group (0.15%), but this was unrelated to LMWH use. The caesarean section rate and the amount of bleeding during delivery were similar in the two groups (32% vs 19% and 500 vs 450 ml, respectively). The risk of major blood loss during labour (&gt;1000 ml) was no higher in the LMWH group compared with the control group. In conclusion, this study indicates that the use of LMWH is safe during pregnancy.</td>
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<tr>
<td>Comparison of perinatal and obstetric outcomes among early adolescents, late adolescents and adult pregnancies in rural South Africa</td>
<td>Hoque, M. and Hoque, S.,</td>
<td>East African Journal of Public Health</td>
<td>2010</td>
<td>The objectives of this retrospective study were to calculate the incidence of the obstetric and perinatal complications at the time of delivery of early adolescent and late adolescent mothers and then compare the same with adult pregnant mothers.</td>
<td>South Africa</td>
<td>Retrospective comparative study</td>
<td>All deliveries in hospital between April-Dec 2004.</td>
<td>Hospital records</td>
<td>2870 deliveries</td>
<td>All women on hospital registry under 21.</td>
<td>Hypertension; Eclampsia; Post-partum haemorrhage.</td>
<td></td>
</tr>
<tr>
<td>Profile of maternal and foetal complications during labour and delivery among women giving birth in hospitals in Matlab and Chandipur, Bangladesh.</td>
<td>Huda, F. A. et al.</td>
<td>Journal of Health, Population, and Nutrition</td>
<td>2012</td>
<td>This paper documents the types and severity of maternal and foetal complications among women who gave birth in hospitals in Matlab and Chandipur, Bangladesh, during 2007-2008. The Community Health Research Workers (CHRWs) of the icddr,b service area in Matlab prospectively collected data for the study from 4,817 women on their places of delivery and pregnancy outcomes. Review of hospital-records was attempted for 2,102 women who gave birth only in the Matlab Hospital of icddr,b and in other public and private hospitals in the Matlab and Chandipur area. Among these, 1,937 records were found and reviewed by a physician.</td>
<td>Bangladesh</td>
<td>Survey and record review</td>
<td>Targeted all pregnant women delivering in Matlab service area in 2007-08</td>
<td>Community Health Research Workers (CHRWs) prospectively gather data on women in icddr,b.</td>
<td>4817 women, with 1097 delivery records reviewed</td>
<td>All abortions excluded.</td>
<td>Haemorrhage: Severe antepartum and postpartum haemorrhage (bleeding with shock or transfused with 2 or more units of blood); Hypertensive disorders of pregnancy: Eclampsia (seizures associated with hypertension, i.e. diastolic blood pressure ≥110 mmHg and severe pre-eclampsia (hypertension with proteinuria ≥+ +, blurred vision, or hyperreflexia); Septic shock or septicemia: genital source of infection and hyperthermia (fever 38.3°C and above for ≥48 hours) or hypotension and low blood pressure (systolic &lt;90 mmHg) and severe pre-eclampsia.</td>
<td></td>
</tr>
<tr>
<td>A multistage model for maternal morbidity during antenatal, delivery and postpartum periods.</td>
<td>Islam, M. A. et al.</td>
<td>Statistics in Medicine</td>
<td>2004</td>
<td>This study employs a multistage model that involves transitions at different stages to complications. The proposed model appears to display more meaningful explanation concerning the impact of different factors on the incidence of complications taking into account types of transitions. Two alternative models are also presented in this paper in order to demonstrate possible simplifications of the proposed model.</td>
<td>Bangladesh</td>
<td>Multistage model</td>
<td>Multistage sampling design used to collect data used in the study</td>
<td>Maternal Morbidity: surveys and interviews.</td>
<td>993 pregnancies.</td>
<td>All pregnancies.</td>
<td>Pregnancy complications: haemorrhage, oedema, excessive vomiting, fits/convulsion; Delivery complications: excessive haemorrhage before or after delivery, retained placenta, obstructed labour, prolonged labour, other complications; Postpartum complications: haemorrhage, other discharge, pelvic pain, cough or fever for more than 3 days, fits/convulsion.</td>
<td></td>
</tr>
<tr>
<td>Systematic review of the magnitude and case fatality ratio for severe maternal morbidity in sub-Saharan Africa between 1995 and 2010.</td>
<td>Kaye, D. K. et al.</td>
<td>BMC Pregnancy and Childbirth</td>
<td>2011</td>
<td>This study assesses the prevalence/incidence of maternal near miss, maternal mortality and case fatality ratio through systematic review of studies on severe maternal morbidity in sub-Saharan Africa. Three studies that reported prevalence/incidence of severe maternal morbidity (maternal near miss) during pregnancy, childbirth and postpartum period between 1996 and 2010 were examined.</td>
<td>Sub-Saharan Africa</td>
<td>Systematic review</td>
<td>12 studies (samples of selected articles varied from 557-23,026).</td>
<td>Medical and social science databases</td>
<td>NA NA</td>
<td>NA</td>
<td>Ruptured uterus; sepsis, obstructed labour; haemorrhage</td>
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By reviewing the hospital records, 7.3% of the women who gave birth in the local hospitals were diagnosed with a severe maternal complication, and 16.2% with a less-severe maternal complication. Twelve maternal deaths occurred during the study period; most (83%) of them had been in contact with a hospital before death.

This study reveals that the women who suffer from one or more of the major complications during pregnancy are expected to have a substantially higher risk of suffering from complications during postpartum period, irrespective of no complications or complications during delivery. Generally speaking, higher economic status can reduce the complications at the postpartum stage, although women belonging to higher economic status may suffer from complications during pregnancy and delivery at a higher rate. It is surprising that antenatal visit is positively associated with incidence of complications during pregnancy and delivery, but antenatal visit reduces complications at the postpartum stage.

12 studies were identified. The sample size varied from 557 women to 23,026. Different definitions and terminologies for maternal near miss included acute obstetric complications, severe life-threatening obstetric complications and severe obstetric complications. The incidence/prevalence ratio and case-fatality ratio for maternal near misses ranged from 1.1% to 10.1% and 3.1% to 37.4% respectively. Ruptured uterus, sepsis, obstructed labor and hemorrhage were the commonest morbidities that were analyzed. The incidence/prevalence ratio of hemorrhage ranged from 0.00% to 3.05%, while the case fatality ratio for hemorrhage ranged from 2.8% to 27.3%. The prevalence/incidence ratio for sepsis ranged from 0.03% to 0.7%, while the case fatality ratio ranged from 0.0% to 7.2%. The incidence/prevalence ratio and case-fatality ratio of maternal near misses are very high in studies from sub-Saharan Africa. Large differences exist between countries on the prevalence/incidence of maternal near misses. This could be due to different contexts/writings, variation in the criteria used to define the maternal near misses morbidity, or rigor used carrying out the study.

Anaemia in pregnancy was considerably high among the early adolescent pregnant women (23%) compared to older adolescent (15%) and adult pregnant women (14%). Other conditions such as pregnancy induced hypertension, edema, and diabetes were not notably different among the groups. Early adolescent mothers were twice (OR = 2.023, 95% CI: 1.185 - 3.373) as likely to be anemic during pregnancy compared to adult mothers. Low birth weight delivery, FSB and MSB rates among the groups were significantly different (p < 0.05).
What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.

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<td>Temporal trends and regional variations in severe maternal morbidity in Canada, 2003 to 2007</td>
<td>Liu, S. et al.</td>
<td>Journal of Obstetrics and Gynaecology Canada</td>
<td>2010</td>
<td>Study aimed to identify temporal trends and regional variations in severe maternal morbidity in Canada using routine hospitalization data.</td>
<td>Canada</td>
<td>Retrospective study</td>
<td>All hospital discharges</td>
<td>Health database</td>
<td>1 336 356 deliveries</td>
<td>All deliveries</td>
<td>Eclampsia; haemorrhage with coagulopathy defect; rupture of uterus before labour; rupture of uterus during labour; puerperal sepsis; intrapartum haemorrhage with blood transfusions; postpartum haemorrhage with blood transfusion; postpartum haemorrhage with hysterectomy.</td>
<td>The overall rate of severe maternal morbidity was 13.8 per 1000 deliveries (95% CI 13.6 to 14.2). Five provinces or territories had rates that were significantly higher than those in the rest of the country: Newfoundland and Labrador (19.0 per 1000; 95% CI 17.2 to 20.8), Saskatchewan (16.9 per 1000; 95% CI 15.9 to 18.0), Alberta (15.4 per 1000; 95% CI 14.9 to 15.9), Northwest Territories (12.5 per 1000; 95% CI 18.0 to 27.7), and Nunavut (10.2 per 1000; 95% CI 14.2 to 27.8). Rates of some illnesses declined (e.g., eclampsia rates decreased from 12.4 in 2003 to 5.7 per 10 000 deliveries in 2007, P&lt;0.001), while others increased (e.g., postpartum haemorrhage with blood transfusion rates increased from 36.6 in 2003 to 44.5 per 10 000 deliveries in 2007, P&lt;0.001).</td>
</tr>
<tr>
<td>Contemporary risks of maternal morbidity and severe outcomes with increasing maternal age and parity</td>
<td>Luke, B. &amp; Brown, M. B.</td>
<td>Fertility and Sterility</td>
<td>2007</td>
<td>Population-based, historic cohort study which evaluated the risks of pregnancy complications and adverse outcomes associated with increasing maternal age and higher parity.</td>
<td>United States</td>
<td>Population-based, historic cohort study.</td>
<td>Entire database</td>
<td>Birth certificates</td>
<td>23320195 deliveries</td>
<td>All singleton, twin, and triplet live births 20 weeks gestation or greater</td>
<td>Pregnancy-associated hypertension; an increase in blood pressure of at least 30 mm Hg systolic or 15 mm diastolic on two measurements taken 6 hours apart after the 20th week of gestation; all excessive bleeding in labour and delivery; this risk was calculated as including the risk factors of abruptio placentae, placenta previa, and other excessive bleeding during labour and delivery.</td>
<td>Compared to singleton, the risks for all adverse outcomes among multiple pregnancies were significantly elevated, and were highest for toxocysis, delivery &lt;20 weeks, and infant mortality. Within pluralities, increasing maternal age was associated with significantly higher risks of pregnancy-associated hypertension, excessive bleeding, and incompetent cervix, but for twin and triplet pregnancies, significantly lower risks for toxocysis (ages &gt;40), singleton adjusted odds ratio (AOR) 0.97, twin AOR 0.67, triplet AOR 0.72, delivery &lt;20 weeks (ages &gt;40), singleton AOR 1.55, twin AOR 0.72, triplet AOR 0.52, and infant mortality (ages &gt;40), singleton AOR 1.14, twin AOR 0.97, triplet AOR 0.42.</td>
</tr>
<tr>
<td>Method of delivery and pregnancy outcomes in Asia: the WHOD global survey on maternal and perinatal health 2007-08</td>
<td>Lumbiganon, P. et al.</td>
<td>Lancet</td>
<td>2010</td>
<td>This Article reports the third phase of the WHOD global survey, which aimed to estimate the rate of different methods of delivery and to examine the relation between method of delivery and maternal and perinatal outcomes in selected facilities in Africa and Latin America in 2004–05, and in Asia in 2007–08.</td>
<td>9 Asian countries: Cambodia, China, India, Japan, Nepal, Philippines, Sri Lanka, Thailand, and Vietnam.</td>
<td>Global retrospective survey of deliveries</td>
<td>All women admitted for delivery for 3 months in selected institutions with 6000 or fewer deliveries, and 2 months in those with more than 6000 deliveries.</td>
<td>Medical records</td>
<td>107950 deliveries</td>
<td>All women giving birth in the study period were included</td>
<td>Pregnancy-induced hypertension; Pre-edema; Eclampsia</td>
<td>The study obtained data for 109 101 of 112 152 deliveries reported in 122 recruited facilities (97% coverage), and analysed 107 950 deliveries. The overall rate of caesarean section was 27.3% (95% CI 29.28–25.3) and of operative vaginal delivery was 3.0% (95% CI 2.94–3.1). Risk of maternal mortality and morbidity index (at least one of: maternal mortality, admission to intensive care unit [ICU], blood transfusion, hysterectomy, or internal iliac artery ligation) was increased for operative vaginal delivery (adjusted odds ratio 2.1, 95% CI 2.1–7.2–6) and all types of caesarean section (antenepartum without indication 2.7, 95% CI 1.4–5.5; antepartum with indication 10.6, 9.3–12.1; intrapartum without indication 14.2, 9.8–20.7; intrapartum with indication 14.5, 13.2–16.0). For breech presentation, caesarean section; either antepartum [0.2, 0.1–0.3] or intrapartum [0.3, 0.2–0.4], was associated with improved perinatal outcomes, but also with increased risk of stay in neonatal ICU (2.0, 1.1–3.6; and 2.1, 1.2–3.7, respectively).</td>
</tr>
<tr>
<td>Impact of maternal age on the incidence of obstetric complications in Japan</td>
<td>Masuda, Y. et al.</td>
<td>The Journal of Obstetrics and Gynaecology Research</td>
<td>2011</td>
<td>This cohort and case-cohort study aimed to clarify the effect of maternal age on obstetric complications. 242 715 births at 125 centres of a perinatal network in Japan from 2001 through 2005 were studied as a base cohort. Women with single pregnancies who delivered after 22 weeks of gestation were included in the study.</td>
<td>Japan</td>
<td>Cohort and case-cohort study</td>
<td>Not clear if initial 242 715 were all deliveries meeting criteria for main cohort in centre (not specified). Subcohort: By random selection 3749 births</td>
<td>Perinatal registry database</td>
<td>242 715 deliveries</td>
<td>Singleton pregnancies with delivery after 22 weeks.</td>
<td>Pregnancy-induced hypertension: systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg occurring after the 20th week of gestation but reaching by the 12th week of postpartum.</td>
<td>The incidence proportion of pregnancy-induced hypertension, cervical insufficiency, placenta previa, and placental abruption increased with age, whereas the incidence proportion of preterm labour and chorioamnionitis were highest at younger maternal age. The RR of women in the age groups 15–19 years and 20–40 years (with the reference of 1.0 for women in the age group of 20–34 years) were determined: pregnancy-induced hypertension, 1.16, 1.25; placenta previa, 1.76, 2.19; and placental abruption, 1.18, 1.5. The RR of preterm labour for women in the age group of &lt;20 years was 1.78.</td>
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What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.

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<tr>
<td>Impact of the Choice on Termination of Pregnancy on maternal morbidity and mortality in the west of Pretoria</td>
<td>Mbale, A.M., Snyman, L. &amp; Patison, R.C.</td>
<td>South African Medical Journal</td>
<td>2006</td>
<td>The objective of this study was to evaluate the impact of the Choice on Termination of Pregnancy Act on maternal morbidity and mortality in the west of Pretoria. Data were collected on all abortions (incomplete or induced) treated in the hospitals in the study area in 1997 - 1998 and 2003 - 2005.</td>
<td>South Africa</td>
<td>Retrospective study</td>
<td>All abortions treated in study area</td>
<td>Medical database</td>
<td>2050 abortions in 1997-98 and 3999 abortions in 2003-05. External referrals excluded.</td>
<td>Critically ill women due to abortion: defined as a woman who had SAAM or who died. Severe morbidity rate for abortion: defined as the percentage of women who were critically ill due to abortion per total abortion cases.</td>
<td>In 1997 - 1998 there were 2050 abortions, of which 80.2% were regarded as being incomplete, and in 2003 - 2005 there were 3999 abortions, of which 43.8% were regarded as incomplete. Twenty-four women who were critically ill due to complications of abortion presented in 1997 - 1998 (a rate of 3.0%/1 000 births), compared with 50 (2.7%/1 000 births) in 2003 - 2005. There were 5 deaths in 1997 - 1998 compared with 1 death in 2003 - 2005. The MMR was 65.6/100 000 births in 1997 - 1998 compared with 5.14/100 000 in 2003 - 2005.</td>
<td></td>
</tr>
<tr>
<td>Maternal and neonatal outcomes of hospital vaginal deliveries in Tibet.</td>
<td>Miller, S. et al.</td>
<td>International Journal of Gynaecology and Obstetrics</td>
<td>2007</td>
<td>The aim of this prospective observational study was to determine the outcomes of vaginal deliveries in three study hospitals in Lhasa, Tibet Autonomous Region (TAR), People’s Republic of China (PRC), at high altitude (3650 m).</td>
<td>Tibet</td>
<td>Prospective cohort study</td>
<td>All women with singleton intrauterine pregnancy of ≥ 28 weeks gestation delivering between January 2004 and May 2005 at 3 maternity hospitals.</td>
<td>Observation, medical records</td>
<td>1121 deliveries.</td>
<td>C-sections excluded.</td>
<td>Postpartum haemorrhage: &gt;500ml, Pre-eclampsia/gestational hypertension.</td>
<td>Pre-eclampsia/gestational hypertension (PE/GH) was the most common maternal complication 10.9% (n=212), followed by postpartum haemorrhage (blood loss &gt; or = 500 ml) 13.4%. There were no maternal deaths. Neonatal complications included: low birth weight (10.2%), small for gestational age (13.7%), pre-term delivery (4.1%) and low Apgar (3.7%). There were 11 stillbirths (0.6/1000 live births) and 19 early neonatal deaths (17/1000 live births).</td>
</tr>
<tr>
<td>Is there an obstetric July phenomenon?</td>
<td>Myleus, T.</td>
<td>Obstetrics and Gynecology</td>
<td>2003</td>
<td>This study examined whether variations in intrapartum management and complications exist with regard to the time of delivery within the academic year.</td>
<td>United States</td>
<td>Retrospective study</td>
<td>All obstetric patients</td>
<td>Hospital records</td>
<td>7814 deliveries</td>
<td>Gestation &gt;20 weeks</td>
<td>Postpartum haemorrhage: defined as &gt; 500 ml for a vaginal delivery and 1000 ml for caesarean; Prolonged second stage of labour: defined as &gt; 120 minutes.</td>
<td>The first half-year overall caesarean rate was higher (15.8% versus 14.9%, P &lt; .05). Primary caesarean rates were similar. No other differences were found by term half year. More perinatal trauma was noted in the fourth quarter (first 3.3%, second 4.5%, third 3.7%, fourth 5.5%, P = .037). Eclampsia usage was higher in both the first and fourth quarters (13.0%, 11.1%, 10.6%, and 14.8%, P &lt; .002). More cases of chorioamnionitis occurred in the fourth quarter (first 3.4%, second 3.1%, third 2.6%, fourth 4.0%, P = .038, third versus fourth quarter). Chorioamnionitis occurred more frequently in July (July 5.0% versus August-June 3.1%, P = .055). There were no other clinically significant differences. In conclusion, although small differences in outcome exist with respect to the academic time of the year, the timing of these differences indicates that there is not a “July phenomenon” in obstetrics at our institution.</td>
</tr>
<tr>
<td>Maternal complications associated with type of delivery in a university hospital</td>
<td>Nomura, R. et al.</td>
<td>Revista de Saúde Pública</td>
<td>2004</td>
<td>The aim of this retrospective study was to analyze maternal complications associated to type of delivery, comparing caesarean section with vaginal delivery.</td>
<td>Brazil</td>
<td>Retrospective study</td>
<td>All deliveries in computer record system of newborn over 500g in period April-Dec 2001.</td>
<td>Hospital records</td>
<td>1748 deliveries</td>
<td>Excluded: newborn weighing under 500g. Hypertensive complications; Puerperal infection: infection originated in the genital apparatus after recent delivery.</td>
<td>C-sections were performed on 988 patients (56.5%). Hemorrhagic complications occurred in 1.2% of c-sections and in 0.8% of normal deliveries, with no statistically significant difference between both groups. Endometritis was observed in 0.4% of c-sections and in 0.2% of vaginal deliveries, without statistically significant difference. Two cases of puerperal infection evolved to hysterectomies, in the c-section group. There were no maternal deaths related to c-section. 2.7% of deliveries were complicated by obstructed labour. Of the 120 women, 68 (56.7%) were nulliparas. A total of 41 women (34.2%) were booked, 70 (58.3%) uncounseled, and 9 (7.7%) booked elsewhere. Most women were in occupational social class V. The cause of obstruction was cephalopelvic disproportion in 68 women (56.6%). The most common intervention was a lower segment caesarean section. Perinatal mortality was 30%. There were four maternal deaths (3.1%).</td>
<td></td>
</tr>
<tr>
<td>Obstructed labour in Enugu, Nigeria.</td>
<td>Nwadi-Uko, E.E., Onwueme, S.O. &amp; Ezeagwui, H.U.</td>
<td>Journal of Obstetrics and Gynaecology</td>
<td>2008</td>
<td>Study of all cases of obstructed labour seen and managed at the University of Nigeria Teaching Hospital, Enugu, Nigeria, between January 1999 and December 2004.</td>
<td>Nigeria</td>
<td>Retrospective study</td>
<td>All deliveries</td>
<td>Hospital records</td>
<td>4521 deliveries</td>
<td>All deliveries</td>
<td>Obstructed labour: labour is obstructed when further progress is not possible due to a mechanical barrier), in spite of the presence of strong uterine contractions without intervention.</td>
<td>In 1997 - 1998 there were 5050 abortions, of which 80.2% were regarded as being incomplete, and in 2003 - 2005 there were 3999 abortions, of which 43.8% were regarded as incomplete. Twenty-four women who were critically ill due to complications of abortion presented in 1997 - 1998 (a rate of 3.0%/1 000 births), compared with 50 (2.7%/1 000 births) in 2003 - 2005. There were 5 deaths in 1997 - 1998 compared with 1 death in 2003 - 2005. The MMR was 65.6/100 000 births in 1997 - 1998 compared with 5.14/100 000 in 2003 - 2005.</td>
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February 2013 39
What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.
What is the evidence on the proportion of pregnancies that result in obstetric complications and require referral to specialist care? A rapid literature review.

| Title                                                                 | Author(s)                                                                 | Publication                                                                 | Year | Description                                                                                                                                                                                                 | Study Country | Type of Study | Sampling Method | Data Source | Sample Size | Eligible subjects | Relevant complications investigated and diagnostic criteria given | Findings                                                                                                                                                                                                 |
|----------------------------------------------------------------------|---------------------------------------------------------------------------|----------------------------------------------------------------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------------|----------------|-------------|-------------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Obstetrical and neonatal outcomes in obese women                      | Roman, H. et al.                                                          | West Indian Medical Journal                                                | 2007 | The objective of this study was to compare the incidence of antenatal and intrapartum complications and neonatal outcomes among pre-pregnant obese women. At the Sud-Reunion Hospital's maternity, Reunion Island, France, over a 54-month period, each obese pregnant woman (BMI = 25–30 kg/m²) delivering a singleton after 22-week gestation was compared to the next age and parity-matched women of normal pre-pregnancy weight (BMI 18.5–25 kg/m²), who delivered after the index case. | Reunion Island (French-owned territory) | Retrospective cohort study | Age and parity-matched women of normal pre-pregnancy weight, delivering after the index case of obese women. Maternity database; 2081 deliveries; BMI 18.5–25 kg/m² | Pre-eclampsia; pregnancy-induced hypertension | Incidences of pre-eclampsia, chronic and pregnancy-induced hypertension, chronic and gestational diabetes mellitus were increased in the obese women group. Prenatal care in obese women required a high rate of hospitalisations as well as a high rate of insulin treatment. Obese women were more likely to be delivered by Caesarean section. The rate of in-uterine foetal death, neonatal and perinatal death was significantly higher in the obese women group. The high BMI in relation with both pre-eclampsia and in-uterine foetal death remained unchanged after adjustment of other risk factors. Obese women were more likely to present several obstetric complications and to be delivered by Caesarean section. |
| Estimation of population-based incidence of pregnancy-related illness and mortality (PRIAM) in two districts in West Java, Indonesia. | Rossmans, C. et al.                                                       | BIOG: an International Journal of Obstetrics and Gynaecology              | 2009 | The objective of this study was to introduce a new and updated approach for the measurement of life-threatening maternal morbidity. By defining complications at the very extreme end of the severity spectrum, this study postulates that the count in hospitals can be used to represent incidence in the general population. All cases of life-threatening obstetric mortality in hospitals and all maternal deaths in the population were counted. Using these data, the study describes the incidence of life-threatening mortality in the total population, examines its variation across geographical areas and investigates its relationship with maternal morbidity. | Indonesia     | Retrospective study | All pregnancy-related admissions in four hospitals, covering almost all pregnancy-related hospital admissions in two districts. Hospital case notes for identification of morbidity; national statistical data for population size; population-based survey reporting births; 2006 pregnancy-related admissions corresponding to 36658 expected births. Eligible: all hospital admissions, which may not be representative of all complications in the population. | All pregnancies, Antepartum haemorrhage (including placenta praevia, placental abruption and unspecified); Postpartum haemorrhage (including uterine atony, retained placenta, tear and unspecified); Pre-eclampsia and Hypertension; Eclampsia; Uterine Rupture; Prolonged labour. A combination of organ dysfunction criteria and management-based criteria used in definitions. For vascular dysfunction: Hypovolaemia requiring four or more units of blood, blood loss with hypovolaemic shock (ysteeks blood pressure <80 mm Hg or undetectable pulse), infusion and/or transfusion of ≥1 l in 2 hours and free-flow infusion. Clinical diagnosis is used for eclampsia, uterine rupture and ectopic pregnancy. Pregnancy but is not clearly described. |
| Uterine rupture incidence, risk factors, and outcomes                 | Rouzi, A. A. et al.                                                       | Saudi Medical Journal                                                     | 2003 | This study reviewed the hospital records of the Maternity and Children’s Hospital (MCH), in Al-Khobar, Kingdom of Saudi Arabia from April 1999 to December 2000 to identify women with ruptured uterus. Relevant data relating to the clinical features, risk factors, operative procedures, and maternal and foetal outcomes were assessed. | Saudi Arabia   | Retrospective study | All records | Hospital records; 23 245 deliveries | All deliveries | Uterine rupture | Incidence of uterine rupture was 2 in 1021 deliveries. Fifteen (65.2%) occurred in women with previous caesarean scar and 8 (34.8%) women had no previous uterine surgery and previous caesarean section there was no maternal death. They were treated by repair of the uterus. Two women sustained bladder injury, and one subsequently developed vesico-vaginal fistula. In contrast, in the 8 women with no previous uterine surgery, one woman died, one woman developed renal failure, and there were 3 foetal losses. Four women needed total abdominal hysterectomy, and 4 women needed repair. Two women needed internal iliac ligation in addition to the hysterectomy. |
| Pregnancy-associated morbidity in Northern Nigeria                    | Salihu, H. M. et al.                                                      | Journal of Obstetrics and Gynaecology                                     | 2004 | This study sought to determine the magnitude and spatiotemporal pattern of maternal morbidity in Kano State, Nigeria. Analysis was on deliveries within the period 1990-1999. | Nigeria        | Retrospective cohort study | All deliveries 1990-1999 | National hospital registry, part of vital statistics system | 171621 deliveries | No exclusions | Maternal complications (not defined). | We counted 59 772 maternal complications among 171 621 deliveries, yielding an overall maternal morbidity rate of 34.8%. We observed yearly variations and increment in the number of complications among magnitude and spatiotemporal pattern of maternal morbidity in Kano State, Nigeria. Analysis was on deliveries within the period 1990-1999. The level of maternal deaths correlated significantly with burden of morbidity (r=0.46, p=0.003). Case fatality rate was 0.9% with temporal fluctuations, and wide variations among the various health institutions. |
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<td>Caesarean section without maternal indications is associated with an increased risk of adverse short-term maternal outcomes: the 2004-2008 WHO Global Survey on Maternal and Perinatal Health.</td>
<td>Souza, J. P. et al.</td>
<td>BMC Medicine</td>
<td>2010 (1)</td>
<td>Multi-center prospective cohort study</td>
<td>24 countries in Africa, Asia, Americas</td>
<td>Multicenter prospective cohort study</td>
<td>Hospital records</td>
<td>All women giving birth at the facility during the study period</td>
<td>286,565 deliveries</td>
<td>Women giving birth at the facility during the study period</td>
<td>Eclampsia, hypertension</td>
<td>The overall caesarean section rate was 25.7% and a total of 1.0 percent of all deliveries were caesarean sections without medical indications, either due to maternal request or in the absence of other recorded indications. Compared to spontaneous vaginal delivery, all other modes of delivery presented an association with the increased risk of death, admission to ICU, blood transfusion and hysterectomy, including antepartum caesarean section without medical indications (Adjusted Odds Ratio (Adj OR), 5.93, 95% Confidence Interval (95% CI), 3.88 to 9.05) and intrapartum caesarean section without medical indications (Adj OR, 14.29, 95% CI, 10.93 to 18.72). In addition, this association is stronger in Africa, compared to Asia and Latin America.</td>
</tr>
<tr>
<td>Maternal near miss and maternal death in the World Health Organization’s 2005 global survey on maternal and perinatal health.</td>
<td>Souza, J. P. et al.</td>
<td>Bulletin of WHO</td>
<td>2010 (2)</td>
<td>Multi-center cross-sectional study</td>
<td>8 Latin American countries</td>
<td>Multi-center cross-sectional study</td>
<td>Hospital records</td>
<td>Excluded from the analysis women with no information on life status in discharge.</td>
<td>57,005 deliveries</td>
<td>All women reporting at least one live birth in the 5 years preceding the interview.</td>
<td>Eclampsia, Hypertension</td>
<td>Of the 97,095 women studied, 2964 (34 per 1000) were at higher risk of dying in association with one or more of the following: being admitted to the intensive care unit (ICU), undergoing a hysterectomy, receiving a blood transfusion, suffering a cardiac or renal complication, or having eclampsia. Being older than 35 years, not having a partner, being a primipara or para &gt; 3, and having had a Caesarean section in the previous pregnancy were factors independently associated with the occurrence of severe maternal morbidity. They were also positively associated with an increased occurrence of low and very low birth weight, stillbirth, early neonatal death, admission to the neonatal ICU, a prolonged maternal postpartum hospital stay and Caesarean section.</td>
</tr>
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<td>Maternal mortality and near miss in the community: findings from the 2006 Brazilian demographic health survey.</td>
<td>Souza, J. P. et al.</td>
<td>BIDOG: an International Journal of Obstetrics and Gynecology</td>
<td>2010 (3)</td>
<td>Secondary analysis of DHS</td>
<td>Brazil</td>
<td>Secondary analysis of DHS</td>
<td>Brazilian Demographic Health Survey (DHS)</td>
<td>Eligible: all women reporting at least one live birth in the 5 years preceding the interview.</td>
<td>6833 pregnancies</td>
<td>Eclampsia: had seizures during pregnancy, delivery and postpartum (and had not had them before); Haemorrhage: had heavy bleeding (wetting clothes, etc.) during pregnancy or in the first 3 days postpartum; Infection: had high fever after delivery/abortion with chills and a malodorous vaginal discharge</td>
<td>Around 32% of women reported complications during pregnancy. The prevalence of maternal near miss in Brazil, using the pragmatic definition, was 21.3 per 1000 live births. An increased risk of severe maternal morbidity was found in women aged &gt;40 years and in those with lower levels of education.</td>
<td></td>
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<tr>
<td>Maternal and neonatal individual risks and benefits associated with caesarean delivery: multicentre prospective study.</td>
<td>Vítkar, J. et al.</td>
<td>BMJ (Clinical Research ed)</td>
<td>2007</td>
<td>Prospective cohort study</td>
<td>8 Latin American countries</td>
<td>Prospective cohort study</td>
<td>Medical records</td>
<td>Excluded: multiple births, emergency caesarean deliveries, women with incomplete delivery data.</td>
<td>94307 deliveries</td>
<td>Women undergoing caesarean delivery had an increased risk of severe maternal morbidity compared with women undergoing vaginal delivery. The risk of antibiotic treatment after delivery for women having either type of caesarean was five times that of women having vaginal deliveries. With cephalic presentation, there was a trend towards a reduced odds ratio for fetal death with elective caesarean, after adjustment for possible confounding variables and gestational age. With breech presentation, caesarean delivery had a large protective effect for fetal death. With cephalic presentation, independent of possible confounding variables and gestational age, intrapartum and elective caesarean increased the risk for a stay of seven or more days in neonatal intensive care and the risk of neonatal mortality up to hospital discharge, which remained higher even after exclusion of all caesarean deliveries for fetal distress. Such increased risk was not seen for breech presentation. Lack of labour was a risk factor for a stay of seven or more days in neonatal intensive care and neonatal mortality up to hospital discharge for babies delivered by elective caesarean delivery, but rupturing of membranes may be protective.</td>
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<tr>
<td>Adverse maternal outcomes in multifetal pregnancies.</td>
<td>Walker, M. C. et al.</td>
<td>BJOG: an International Journal of Obstetrics and Gynaecology</td>
<td>2004</td>
<td>This is a retrospective cohort study comparing the incidence of complications in 165,188 singleton pregnancies and 44,674 multiple-fetal pregnancies in Canada from 1984 to 2000.</td>
<td>Canada</td>
<td>Retrospective cohort study</td>
<td>All multiple gestations selected from Discharge Database of Canadian Institute of Health Information (representative of all births in Canada), and 4 singleton matches selected for each</td>
<td>Discharge Abstract Database</td>
<td>165,188 singleton; 44,674 multiple births</td>
<td>All deliveries</td>
<td>Pre-eclampsia; postpartum haemorrhage</td>
<td>Multiple gestation pregnancies were associated with significant increases in cardiac morbidity, hematologic morbidity, amniotic fluid embolus, pre-eclampsia, gestational diabetes, postpartum hemorrhage, prolonged hospital stay, the need for obstetric intervention, hysterectomy and blood transfusion. Multiple gestation pregnancies are associated with an increased risk of morbidity for the mother.</td>
</tr>
<tr>
<td>Incidence of severe pre-eclampsia, postpartum haemorrhage and sepsis as a surrogate marker for severe maternal morbidity in a European population-based study: the MOMS-B survey.</td>
<td>Zhang, W. H. et al.</td>
<td>BJOG: an International Journal of Obstetrics and Gynaecology</td>
<td>2005</td>
<td>The objective of this study was to describe the incidence of three conditions of acute severe maternal morbidity in selected regions in nine European countries. Eleven regions in nine countries of Europe were selected, with all the pregnant women in each region who had delivered during the period covered by the study. The incidence of three main severe obstetric conditions was measured: pre-eclampsia, postpartum haemorrhage and sepsis.</td>
<td>9 European countries</td>
<td>Retrospective survey, descriptive analysis</td>
<td>Survey in 11 countries, some by region, some by entire country. Population based questionnaire survey</td>
<td>-</td>
<td>182,734 women</td>
<td>Women completing 24 weeks gestation and with 1 or more of the conditions considered.</td>
<td>Severe pre-eclampsia; eclampsia; severe haemorrhage; sepsis</td>
<td>The study identified 1734 women with at least one of the three conditions, with 447 experiencing severe haemorrhage, 793 experiencing severe pre-eclampsia and 142 experiencing severe sepsis. There were wide variations in incidence of three conditions combined, ranging from 14.7 per thousand deliveries in Brussels, Belgium to 6.0 per thousand deliveries in Upper Austria.</td>
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Annex 6 Bibliography of articles retrieved for evaluation

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60. Zhang, W.-H. et al., 2005. Incidence of severe pre-eclampsia, postpartum haemorrhage and sepsis as a surrogate marker for severe maternal morbidity in a European population-based
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