

The global met need for emergency obstetric care: a systematic review

H Holmer,^{a,b} K Oyerinde,^c JG Meara,^{a,d} R Gillies,^{a,d} J Liljestrand,^e L Hagander^{a,b}

^a Program in Global Surgery and Social Change, Department of Global Health and Social Medicine, Harvard Medical School, Boston, MA, USA ^b Department of Clinical Sciences in Lund, Paediatric Surgery and Global Paediatrics, Faculty of Medicine, Children's Hospital, Lund University, Lund, Sweden ^c Averting Maternal Death and Disability Program, Heilbrunn Department of Population and Family Health, Mailman School of Public Health, Columbia University, New York, NY, USA ^d Department of Plastic and Oral Surgery, Children's Hospital Boston, Boston, MA, USA ^e Division for Social Medicine and Global Health, Department of Clinical Sciences, Lund University, Malmö, Sweden

Correspondence: H Holmer, Department of Clinical Sciences, Lund, Paediatric Surgery and Global Paediatrics, Faculty of Medicine, Lund University, Children's Hospital, Lasarettsgatan 40, 22185 Lund, Sweden. Email hampus.holmer@med.lu.se

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Background Of the 287 000 maternal deaths every year, 99% happen in low- and middle-income countries. The vast majority could be averted with timely access to appropriate emergency obstetric care (EmOC). The proportion of women with complications of pregnancy or childbirth who actually receive treatment is reported as 'Met need for EmOC'.

Objective To estimate the global met need for EmOC and to examine the correlation between met need, maternal mortality ratio and other indicators.

Search strategy A systematic review was performed according to the PRISMA guidelines. Searches were made in PubMed, EMBASE and Google Scholar.

Selection criteria Studies containing data on met need in EmOC were selected.

Data collection and analysis Analysis was performed with data extracted from 62 studies representing 51 countries. World Bank data were used for univariate and multiple linear regression.

Main results Global met need for EmOC was 45% (IQR: 28–57%), with significant disparity between low- (21% [12–31%]), middle- (32% [15–56%]), and high-income countries (99% [99–99%]), ($P = 0.041$). This corresponds to 11.4 million (8.8–14.8) untreated complications yearly and 951 million (645–1174 million) women without access to EmOC. We found an inverse correlation between met need and maternal mortality ratio ($r = -0.42$, $P < 0.001$). Met need was significantly correlated with the proportion of births attended by skilled birth attendants ($\beta = 0.53$ [95% CI 0.41–0.65], $P < 0.001$).

Authors' conclusions The results suggest a considerable inadequacy in global met need for EmOC, with vast disparities between countries of different income levels. Met need is a powerful indicator of the response to maternal mortality and strategies to improve EmOC act in synergy with the expansion of skilled birth attendance.

Keywords Emergency obstetric care, maternal health, met need, obstetrics, skilled birth attendance.

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Introduction

Over a quarter of a million women die every year due to complications of pregnancy or childbirth, and most could have been saved by emergency obstetric care.^{1–3} Approximately 99% of all maternal deaths occur in low- and middle-income countries (LMIC), representing the greatest single health disparity between resource-rich and resource-poor countries.^{4,5} The United Nations Millennium Development Goals to decrease maternal and child mortality would benefit directly from safer pregnancy and delivery,⁶

but it is unlikely that the goals will be reached by 2015. Thousands of unnecessary deaths continue to occur every year due to the complications of pregnancy.⁷ Timely identification, referral to emergency obstetric care (EmOC) facilities and prompt treatment of potentially life threatening conditions is one strategy to tackle this issue effectively.⁸

The leading global causes of maternal deaths are haemorrhage and hypertension.^{6,9} It has been estimated that approximately 15% of all pregnant women experience obstetric complications (Supporting Information Figure S1).^{5,6,9,10} These complications occur regardless of socioeconomic

status and level of health care provided, and generally cannot be predicted or prevented.^{11–17} The low maternal mortality in high-income settings is explained largely by prompt diagnosis and treatment of complications. To decrease maternal mortality in low-income countries, diagnosis and treatment of obstetric complications must be improved.⁵

The complications of pregnancy and childbirth are treated through provision of EmOC. A framework for evaluation and improvement of EmOC services was developed in 1991, proposing a number of indicators for monitoring progress in EmOC quality, availability and access. One of these indicators, met need for EmOC, captures the proportion of women with obstetric complications who are actually treated.⁸ This measure of access has proven highly useful for policy makers, non-governmental organisations and funding agencies.¹⁸ A comprehensive global compilation and analysis of available data on met need for EmOC has not been attempted to date.

Study objective

The purpose of this study was to identify, describe and analyse global data on met need for EmOC and to explore the correlation of met need with maternal mortality and other indicators of obstetric care used at national level.

Methods

Study design

A systematic review was conducted on levels of met need for emergency obstetric care, investigating their association with maternal mortality and national health indicators. Data on met need for EmOC were collected through a systematic literature search in accordance with the PRISMA statement for reporting systematic reviews¹⁹ and were compared with indicators made available by the World Bank.²⁰

Eligibility criteria

Studies containing data on met need for EmOC were included if they were in the form of peer-reviewed articles and publicly available reports published since the conception of the EmOC framework in 1991.⁸

Information sources and search strategy

PubMed and EMBASE were searched using the terms ‘emergency obstetric care’, ‘emergency obstetric services’, ‘EmONC’ and ‘EmOC’. Google Scholar was searched using a combination of the terms ‘met need’ and ‘emergency obstetric care’. Reports from the reference list of identified studies were retrieved and Google searches for ‘Met need for Emergency Obstetric Care’ were carried out in English, Spanish, Portuguese and French in an attempt to identify non-indexed reports. All searches were carried out up to 7 November 2013. Recent non-indexed reports were

provided by the Averting Maternal Death and Disabilities (AMDD) Program at Columbia University (New York, NY, USA).

Study selection

The search yielded 739 studies which were manually screened by title and abstract for inclusion in the full text review. A total of 565 studies did not include EmOC indicators and were excluded. Of the 174 full text studies read, 62 contained data on met need and were therefore included in the quantitative analysis (Figure 1).

Data collection

Data were extracted from the 62 studies, with several data points from some countries. Duplicate data were excluded but data representing different years for the same country were included. A total of 142 measurements of met need for EmOC were extracted. Where met need was reported separately from several regions within one country in the same year, the national met need was calculated based on district populations. EmOC facilities included those that performed certain key (signal) functions and others that did not perform all of those functions (elaborated further under ‘definitions’). Data representing both types of EmOC facilities were entered separately and in statistical analysis, data from all facilities were used where available. Sub-national data were assumed to represent the whole country where no national data were available.

Definitions

Maternal mortality ratio is defined as the number of deaths among women who are pregnant or within 42 days of termination of pregnancy, per 100 000 live births, irrespective of the duration and site of the pregnancy, from any cause

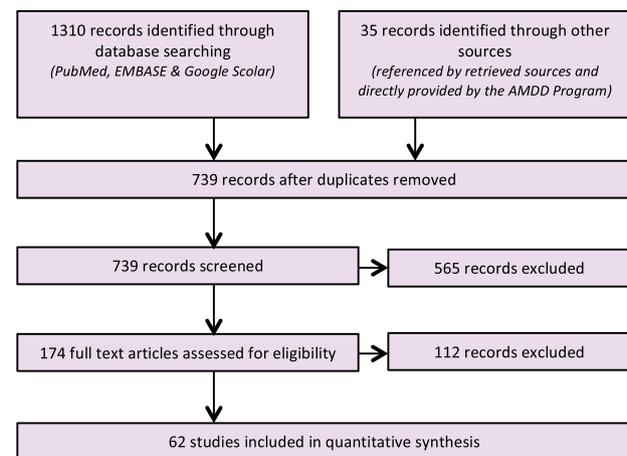


Figure 1. Selection process for reports and studies containing met need for emergency obstetric care data (PRISMA Statement Flow Diagram).

related to or aggravated by the pregnancy or its management but not from accidental or incidental causes.²¹

The EmOC framework, developed by the AMDD Program at Columbia University (New York, NY, USA) in 1991 commissioned by the United Nations Children's Fund (UNICEF)⁸ was tested in 1992 and published in 1997.²² A revised version of the guidelines was published in 2009.⁸ The most severe complications of pregnancy and childbirth, called 'major direct obstetric complications', are defined within the EmOC framework as antepartum and postpartum haemorrhage, prolonged or obstructed labour, postpartum sepsis, complications of abortion, severe pre-eclampsia and eclampsia, ectopic pregnancy and ruptured uterus (Supporting Information Table S1).⁸ To define EmOC facilities, well-defined key interventions for treatment of these complications, so-called signal functions, are used (Table S1). Basic EmOC facilities are those where within the past 3 months the following interventions have been performed at least once: administration of parenteral antibiotics, uterotonic drugs, and parenteral anticonvulsants for pre-eclampsia and eclampsia (i.e. magnesium sulphate), manual removal of the placenta and retained products (by manual vacuum extraction, or dilation and curettage), assisted vaginal delivery (by vacuum extraction or forceps delivery) and basic neonatal resuscitation (e.g. with bag and mask). At comprehensive EmOC facilities, obstetric surgery (e.g. caesarean section) and blood transfusion are performed, in addition to the basic EmOC functions (Supporting Information Table S2). Facilities that did not provide one or more of these signal functions in the last 3 months preceding a survey are generally not qualified as EmOC facilities.⁸

Met need for EmOC designates the proportion of expected complicated deliveries (with major direct obstetric complications) that are in fact treated in EmOC facilities.⁸ While the number of patients with major obstetric complications treated in a facility can be found by reviewing patient records over a given period, the number of expected complicated deliveries in a population has to be estimated. The World Health Organization (WHO) estimates that 15% of live births can be expected to have complications. The denominator for met need for EmOC is thus 15% of the estimated number of live births in a defined geographical area, while the numerator is defined by the number of complications treated in EmOC health facilities in the same area (Figure 2).⁸

The global met need for EmOC

To estimate the global met need for EmOC, the most recent met need data were selected for each country. The

distribution of EmOC did not meet the requirements of normality, so median and interquartile range were reported, and differences in met need for EmOC between low-income countries, middle-income countries and high-income countries were assessed with the non-parametric Kruskal–Wallis *H*-test. The annual number of births in each income category was calculated using the most recent crude birth rate (annual live births per 1000 population²³), multiplied by the most recent population in each income category. Of these births, 15% were estimated to be complicated. Using the median met need for each income category, a total number of treated complications could be calculated. Dividing the global number of treated complications by the estimated total number of complications yielded a value for the global met need for EmOC. Further, the number of untreated complications could be derived from this calculation by multiplying the unmet need for EmOC with the estimated number of complications by income category. Finally, the number of fertile women without access to EmOC should they become pregnant was calculated based on United Nations population data.²⁴ The number of women at 15–49 years of age by income category in 2010 was extrapolated to the population of each income category in 2012 and multiplied by unmet need for EmOC. All countries with populations above 30 000 (214 in total) were included in the calculations of global met need, and country names and regional and income groupings (low income, lower-middle income, upper-middle income and high income) were used in accordance with the World Bank classification.^{23,25,26}

Correlation of met need for EmOC with maternal mortality ratio

Met need for EmOC and national estimates of maternal mortality were matched by country. The most recent national maternal mortality ratio at or prior to the survey year was used, and countries with missing data points excluded. A total of 116 data points were included, and a scatter plot was created with a fitted trend line, providing the coefficient of determination (R^2), and Pearson correlation coefficient (r).

Correlation of met need for EmOC with other indicators

Association was examined between met need for EmOC and other publicly available national indicators matched by year and country. Indicators were retrieved from the World Bank's World Data Bank by year, country and indicator.²⁰ A total of 33 indicators, listed and defined in Supporting

$$\text{Met need for EmOC} = \frac{\text{Number of women with complications treated in surveyed facilities}}{15\% \text{ of the estimated number of births in the uptake population of surveyed facilities}}$$

Figure 2. Calculation of met need for emergency obstetric care.

Information Table S3, from 214 countries, were retrieved for all years between 1990 and 2012. Levels of national indicators by income group and previously published correlations with maternal mortality are shown in Supporting Information Table S4. For each value of met need indicators were matched for year and country. In cases of missing values, the most recent value before the study year (up to 1990) was used. Multiple data points were included as independent observations for countries where values were available for multiple years.

Univariate linear regression was performed for each indicator, with met need for EmOC as the dependent variable, yielding regression coefficients with 95% confidence intervals and *P*-values. Using the indicators that had shown significant correlation at $P < 0.05$ in univariate linear regression, multivariate linear regression was then carried out using a forward stepwise selection process with EmOC as dependent variable. To decrease the risk of listwise deletion in multivariate regression multiple imputation was performed (500 imputations), replacing missing values for indicators in the data set.

Data entry and analysis software

Data were entered into Microsoft EXCEL 2011 for Mac (version 14.3.6; Microsoft Corporation, Redmond, WA, USA) and statistical analysis was carried out in IBM SPSS 22 for Mac (version 22.0.0.0; International Business Machines Corporation, Armonk, NY, USA).

Ethical considerations

No ethical approval was sought. There may be important ethical considerations involved with data collection in the original surveys, but as we are using aggregated data from those sources, there should be no additional ethical considerations.

Results

Data were extracted from a total of 62 studies (Figure 1), containing data from 1992 to 2011, from 51 countries. The chronological and geographical distribution of the surveys

is presented in Supporting Information Figure S2. Surveys are listed with reference, survey year, area and population served, number of facilities surveyed and met need for EmOC in Supporting Information Table S5.

Global met need for EmOC

Included surveys showed levels of met need for EmOC of 2–99%. A global met need for EmOC level of 45% (interquartile range 28–57%) was estimated, or 21% (12–31%) in low-income countries, 28% (15–50%) in lower middle-income countries, 51% (33–73%) in upper middle-income countries and 99% (99–99%) in high-income countries. There was a significant difference in met need for emergency obstetric care among low-income countries, middle-income countries and high-income countries ($P = 0.04$) (Figure 3). Worldwide, 951 million women of reproductive age (interquartile range 645–1174 million) do not have access to EmOC should they become pregnant. This corresponds to over 11 million (9–15 million) untreated complications every year.

How met need correlates with maternal mortality

The Pearson correlation between met need for EmOC and maternal mortality ratio is shown in Figure 4. A negative correlation was seen, with an R^2 of 0.18 and Pearson's r of -0.424 , $P < 0.001$.

Factors correlating with met need

In univariate regression analysis, met need for EmOC was significantly associated with all investigated access and demographic indicators, as well as female primary school enrolment (Supporting Information Table S6). Two transport/communication indicators were also significantly associated, as well as prevalence of anaemia in pregnancy and malnutrition in children under 5. Seven of the 33 investigated indicators showed statistically insignificant association at $P < 0.05$. Due to considerable multicollinearity among the univariately significant covariates, only the proportion of births attended by skilled health personnel was

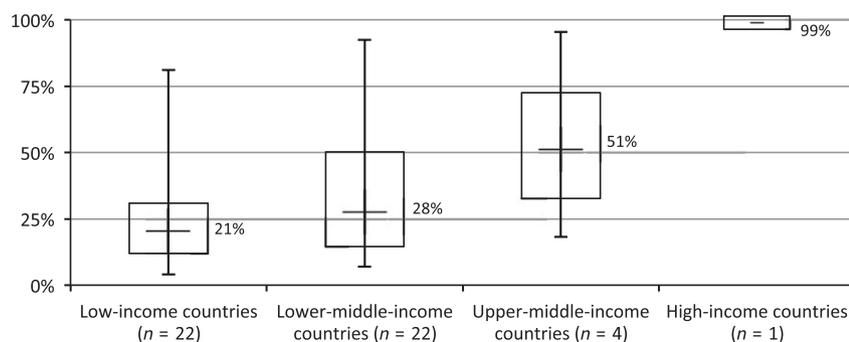


Figure 3. Met need for emergency obstetric care, by World Bank income categories. Box plots show the median value, interquartile range and maximum and minimum values for met need for EmOC. *n* designates the number of countries with data within each income category.

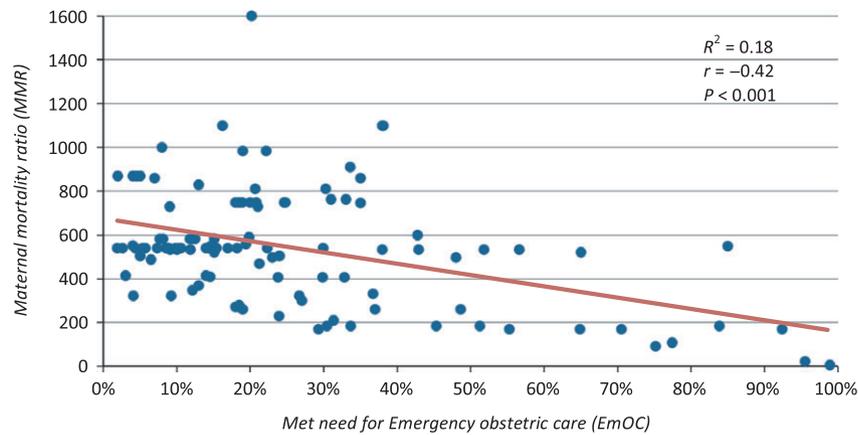


Figure 4. Correlation between met need for emergency obstetric care and maternal mortality ratio.

significantly associated with met need for EmOC in stepwise multivariate linear regression, as presented in Supporting Information Table S7 ($r^2 = 0.28$). For every percent increase in attended births, the met need increased by 0.53 percentage points (0.41–0.65) ($P < 0.001$).

Discussion

Globally, more than half of women with maternal complications lack access to EmOC and there are significant differences among countries of various income categories. Met need for EmOC was inversely correlated with maternal mortality ratio. The proportion of births attended by health personnel was found to be a predictor for met need.

These findings are based on the most comprehensive compilation of data on met need to date. Met need for EmOC has been described as one of the most useful indicators of the performance of a health system in meeting women's obstetric needs.¹⁸ Its relevance was reiterated by a case report on EmOC in the 2013 WHO World Health Report, which concluded that provision of EmOC, together with a functional patient referral and transportation system, can significantly lower maternal mortality.²⁷

Limitations

This systematic review was limited by the number of countries surveyed and the quality of data. Data were only available from 51 of the 194 WHO member countries. High-income countries were represented by only one country (USA). The varying availability of meta-data in the included studies made assessments of study quality difficult.

The EmOC framework has been criticised for not adequately capturing the quality of care received¹⁸ or the general condition of the patients at admission.^{28,29} Also, diagnostic and patient documentation issues at the point of care may lead to under- or over-reporting of the number of maternal complications treated.¹⁸ The non-inclusion of

abortion complications and ectopic pregnancies in the numerator for met need may have been influenced by legal and cultural factors surrounding abortion, rather than the organisation and delivery of care. These highly important factors may skew the measurement of met need.^{30–32} Met need may be underestimated when facilities not designated as EmOC facilities or private facilities are excluded.¹⁸ The extent to which sub-national levels of met need for EmOC can be extrapolated to the whole country is put into question by the variation in levels of national coverage among the surveys included in this study, but lack of consistent reporting of data samples made validation impossible.

The use of 15% of live births as the estimated number of maternal complications has been challenged.^{8,18,30} The WHO has decided not to alter this figure, supported by a series of studies from the USA and India indicating that the figure is reasonable.^{33–36} Complication rates may vary across countries and settings,³⁰ with factors such as malnutrition in childhood, early age at first pregnancy and untreated diabetes potentially increasing the risks of complications^{37,38} and disproportionately affecting the poor.

Poor medical records, uncertain estimates of populations and poor sampling of health facilities may have biased the results of individual studies. Publication bias may be present. Authors' interests may have precluded publication. There are countries where data have been collected but have not yet been released. Our estimates are based on the assumption that available reports are representative of the levels of met need for EmOC in similar countries, but there could be selective reporting. Countries where surveys could not be carried out (such as conflict areas) may have less well functioning maternal health care systems, with a lower met need for EmOC.

Finally, imputation of missing values, necessary to avoid listwise deletion, may have skewed certain values. A number of additional indicators would have been investigated had they been more readily available, such as indicators of health

care capacity, abortion, barriers to access to health care facilities, density and access to obstetrical or surgical specialists.

EmOC depends on much more than only adequately staffed and technically equipped EmOC facilities. Our results confirm that increasing skilled birth attendance acts in synergy with increased EmOC access. This is logical, in that women attended by a midwife are more likely to reach an EmOC facility in time to receive treatment. This is especially true of referrals from basic facilities—apart from a skilled midwife, there is a road from the basic facility, often telecommunications available and transport. In many countries, there is also collaboration between health centre and hospital staff, leading to improvements in care, coverage and outcome. Countries such as Burkina Faso, Cambodia, Indonesia and Morocco have increased both access to and quality of care for complications.^{39,40} Broader health system collaboration, not least with the fields of surgery and anaesthesia, are necessary.⁴¹ Systematic strengthening of midwifery care is fundamental, as is attention to non-health system factors such as poverty reduction, economic growth, female education and the improvement of roads and telecommunications. A strong background determinant is the value given to maternal health in a society, along with increasing the effectiveness of vital event reporting including maternal deaths.

Coverage has been a focus, and until recently the quality of maternal and neonatal care has received less attention. Quality improvement mechanisms are linked to all of the above-mentioned components—prioritising maternal health, monitoring, and changing both the health sector response and the prerequisites in society. The establishment of regular, focused quality improvement efforts within maternal health care seem fundamental. These should go beyond national guidelines and intermittent training, and aim at regular continuous medical education, regularly addressing linkages between peripheral and central units, and using audit mechanisms.³⁹

Conclusion

The results of this systematic review suggest that the global met need for EmOC remains deplorably low, with gross disparities between high and low income countries. Met need for EmOC correlates with skilled birth attendance and inversely with maternal mortality ratio. This stresses the importance of access to well-functioning health systems for both skilled birth attendance and EmOC for decreasing maternal mortality and morbidity. Better data are needed to inform health policy priorities. Met need can be used to monitor access to health services and universal health coverage. Decreasing avoidable maternal mortality and morbidity through strengthening sexual and reproductive health care in general should remain a top priority in global and national health agendas.

Disclosure of interests

HH, LH, JL, RG and JGM have no interests to disclose. KO is a member of the AMDD program at Columbia University and has authored some of the included studies.

Contribution to authorship

HH had the leading role in planning, carrying out, analysing and writing this study. LH conceived and took part in planning, carrying out, analysis and writing of the study. JL, RG, KO and JGM supported planning, carrying out, analysis and writing of the study.

Details of ethics approval

No ethics approval necessary.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Figure S1. Causes of maternal deaths: Global estimates.

Figure S2. Number of surveys for met need for emergency obstetric care by survey year and World Bank Region.

Table S1. Definitions and corresponding signal functions for major direct obstetric complications.

Table S2. Definitions and acceptable levels for indicators of emergency obstetric care services.

Table S3. Definition of national indicators examined for association with levels of met need for emergency obstetric care (EmOC).

Table S4. Levels of national indicators by income group and previously published correlation with maternal mortality ratio.

Table S5. Met need for emergency obstetric care (EmOC) by country and year of survey included in systematic review, with survey characteristics.

Table S6. Univariate linear regression with met need for emergency obstetric care as dependent variable.

Table S7. Stepwise multivariate linear regression with met need for emergency obstetric care as dependent variable. ■

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