Disease burden due to pre-eclampsia/eclampsia and the Ethiopian health system’s response

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\begin{abstract}
Objective: To assess the maternal disease burden due to pre-eclampsia/eclampsia in Ethiopia and the national health system’s readiness to respond to the needs of women with pre-eclampsia/eclampsia. Methods: The national emergency obstetric and newborn care (EmONC) assessment entailed collecting information from 112 hospitals and 685 health centers in Ethiopia, focusing on their infrastructure, the services they provided, human resources, equipment and supplies, case load, and mortality due to pre-eclampsia/eclampsia. Results: Pre-eclampsia/eclampsia complicated 1.2% of all institutional deliveries. Given the low institutional delivery rate and an expected incidence of 2%-8% of all deliveries, this implies that only a small fraction (3.8%) of all women with pre-eclampsia/eclampsia received care at health facilities. 11% of all maternal deaths and 16% of direct maternal deaths were due to this obstetric complication. The cause-specific case fatality rate was high (3.6%). Availability of urine test strips, anticonvulsants, antihypertensives, and actual service provision to treat these diseases was limited, especially at health centers. Conclusion: The salutary effects of the national EmONC assessment were immediate, as evidenced by how quickly the release of the Ethiopian report led to important national efforts to improve maternal and newborn health. Expansion of health services should be augmented with periodic assessments of logistics and quality-related issues to assure functioning facilities for women accessing obstetric services.
\end{abstract}

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1. Introduction

Pre-eclampsia/eclampsia is a common complication affecting 2%-8% of pregnancies\textsuperscript{[1]}. WHO estimates that the incidence of pre-eclampsia is 7 times higher in low- and middle-income countries than in high-income countries, and the risk of a woman in a low-income country dying of pre-eclampsia/eclampsia is 300 times that of a woman in a high-income country\textsuperscript{[2,3]}. The risk of death due to pre-eclamptic disease increases when eclampsia supervenes on the clinical picture. Pre-eclampsia/eclampsia is responsible for an estimated 16% of global maternal mortality (or 63,000 maternal deaths) annually\textsuperscript{[4]}. The risk of maternal death is much more common in settings in which prenatal and intrapartum care is not routinely available to pregnant women.

The etiology of pre-eclamptic disease is unknown, and no disease-specific therapy or preventive approach is available\textsuperscript{[5]}. Improvements in disease outcome have resulted from routine prenatal care provision to all pregnant women and early detection of the syndrome through blood pressure measurement and urinary protein testing. In fact, early historic reductions in the incidence of eclampsia in high-income countries have been attributed to increased access to prenatal and hospital care for all pregnant women\textsuperscript{[6]}. Institutional care with close maternal monitoring; prevention and control of seizures through the use of anticonvulsants; treatment of severe hypertension; and timely termination of pregnancy reduce maternal mortality and serious morbidity. Until the cause of pre-eclampsia is identified and specific therapy made available, these symptomatic management approaches offer the only option for reducing maternal and perinatal mortality ascribed to the syndrome\textsuperscript{[5]}.

The provision of parenteral anticonvulsants to pre-eclamptic/eclamptic women is one of the 9 emergency obstetric care (EmOC) signal functions vital to the reduction of maternal mortality\textsuperscript{[7]}. Large multicenter trials have shown that magnesium sulfate is superior to other anticonvulsants in the prevention and control of eclamptic seizures\textsuperscript{[8-11]}. Prompt administration of magnesium sulfate reduces...
the risk of seizure recurrence by half and significantly reduces the risk of maternal deaths. Control of severe hypertension is also important in reducing maternal mortality and morbidity due to cerebrovascular accidents. This is often achieved through the administration of effective parenteral antihypertensive agents such as hydralazine or labetalol. Termination of pregnancy leads to rapid regression of pre-eclamptic disease, often without residual effects [5]. A small proportion of women with pre-eclampsia/eclampsia also require intensive care for vital-organ support for relatively short periods. The readiness of the health system to provide these life-saving services to women who develop this syndrome is paramount to reducing maternal mortality and morbidity, as well as improving neonatal survival. Pre-eclampsia/eclampsia may contribute to as much as 25% of all stillbirths and neonatal deaths [12].

Many low-income countries have weak health systems that are unable to provide optimal health services to pregnant women and their neonates. Focusing on the provision of a core minimum package of services addressing common direct causes of maternal mortality is a responsive and targeted strategy. The availability of basic and comprehensive EmOC 24 hours per day, 7 days per week—in conjunction with a functioning referral system—is thought to prevent most maternal deaths with direct causes [7].

Favorable maternal and newborn outcomes are also dependent on events or circumstances outside the health system—such as health-seeking behavior, and roads or transport. The latter are often associated with the 1st and 2nd delays (the decision to seek care and reaching appropriate care) in the 3-delays model regarding maternal mortality. Periodic evaluations of health system readiness to provide EmOC are important for understanding the extent of the 3rd delay (timely and appropriate treatment on arrival at a facility). The primary objective of the Ethiopian national emergency obstetric and newborn care (EmONC) assessment, which was undertaken by the Federal Ministry of Health and its partners, was to measure how well the national health services function in response to obstetric and newborn emergencies [13].

Sections of the evaluation focused on readiness to diagnose and manage pre-eclampsia/eclampsia, as well as measuring the contribution of this complication to the overall maternal and neonatal disease burden captured by the health system. As a near census of all facilities providing maternal health care in the country, the study is the first of its kind in Ethiopia to assess the magnitude of disease burden and the extent of the health system response to it. The present article is part of a series summarizing the findings of this assessment. The specific focus of this paper is to assess the national health system's readiness to diagnose and manage pre-eclampsia/eclampsia, estimate the burden of disease and its contributions to overall maternal ill health, and provide information needed to strengthen national EmONC provision.

2. Methods

The Ethiopian EmONC assessment was a national, cross-sectional, facility-based survey that utilized 10 data collection instruments. Data collection was undertaken from October 1, 2008, to January 15, 2009. Data collection instruments were adopted from a set of standard modules that have been used in many countries worldwide; the instruments were pretested in Addis Ababa health facilities prior to field work. Eighty-four data collectors—all health professionals—were recruited and trained extensively on the data collection process and instruments. Data collectors worked in teams of 4. A private research firm was contracted to coordinate the field work and data management process. Data entry screens were created in the software program CSPro (US Census Bureau, Suitland, MD, USA), and double data entry was performed in Addis Ababa. Various levels of quality assurance were used during field work, data entry, and analysis. A more detailed description of the methods can be found in the final report and elsewhere in this issue of the journal [13,14].

Data were collected at 112 hospitals and 685 health centers/clinics nationwide. Although intended to be a full census of all public and private facilities (hospitals, health centers, and higher clinics), a small number of private higher clinics and hospitals were excluded because their names did not appear on the list of licensed facilities, they provided no maternity services, or they declined to participate in the survey.

Readiness to diagnose and manage pre-eclampsia/eclampsia was compiled from relevant sections of the report. Variables of relevance extracted from the main report and database included the availability of prenatal, delivery, and postnatal care services; status of user fees; and the availability of human resources providing specific basic and emergency obstetric services. The assessment examined the availability of essential drugs and equipment for the diagnosis and management of pre-eclampsia, including anticonvulsants (availability and utilization); antihypertensive drugs; intravenous sets (IV stand, giving set, IV cannulae, and fluids); suction and anesthesia equipment; blood pressure cuff and stethoscope; and urine test strips for measuring urinary protein.

Disease burden due to pre-eclampsia/eclampsia was assessed by looking at the proportion of cases per total deliveries; per direct and indirect complications; per direct obstetric complications only; per indirect maternal deaths; per direct maternal deaths only; the proportion of cesareans due to pre-eclampsia/eclampsia; and the cause-specific case fatality rate due to pre-eclampsia/eclampsia. These service statistics were extracted from facility logbooks and registers, and spanned 12 consecutive months (July 2007–June 2008).

The working definitions of pre-eclampsia and eclampsia, as set forth in the training of data collectors, were as follows:

• Severe pre-eclampsia: diastolic blood pressure of 110 mm Hg or higher; proteinuria of 3+ or higher after 20 weeks of pregnancy; various signs and symptoms, including headache, hyperreflexia, blurred vision, oliguria, epigastric pain, and pulmonary edema.
• Eclampsia: convulsions; diastolic blood pressure of 90 mm Hg or higher after 20 weeks of pregnancy; proteinuria of 2+ or higher; signs and symptoms of severe pre-eclampsia may be present.

Data were tabulated—stratifying by health centers and hospitals, as well as total facilities surveyed.

3. Results

3.1. Disease burden

The vast majority of deliveries in Ethiopia took place at home, with only 6%–7% occurring in institutions [13,15]. The Ethiopian national EmONC assessment documented 174,561 deliveries at the 797 facilities surveyed. Pre-eclampsia/eclampsia contributed to a significant maternal disease burden among pregnant and recently delivered women seeking care at the facilities (Table 1). Approximately 1% of all deliveries and 5% of all women with complications were documented as having severe pre-eclampsia/eclampsia. However, nearly 16% of direct maternal deaths were due to pre-eclampsia/eclampsia. Overall, 10% of maternal deaths (direct and indirect) occurred among women whose pregnancies were complicated by pre-eclampsia/eclampsia. A relatively high case fatality rate of 3.6% was noted among all pre-eclamptics/eclampsics who received care at the facilities.

3.2. Availability of services

Table 2 shows the availability of essential maternal health services spanning the different phases of pregnancy. Most of the health centers and hospitals in Ethiopia provide prenatal, delivery, and postnatal care services—all of which present opportunities for the detection of pre-eclamptic disease. Because pre-eclampsia is often asymptomatic,
its detection is dependent upon routine blood pressure measurements, followed by a urinary protein test for those with elevated blood pressure. Pre-eclampsia/eclampsia can present at all phases of pregnancy; therefore, ready availability of care at all phases in most facilities would facilitate its detection and management. User-fee charges for consultation and fees for a normal delivery or supplies were in place at more than half of the facilities, despite policies to the contrary—indicating a potential barrier to accessing care, especially because pre-eclampsia is commonly encountered among low socioeconomic groups. Only 1 health center in 8 reported a functional ambulance on site, and not all hospitals had one.

3.3. Trained providers

The availability of providers with specific EmONC training was limited, with the shortage more pronounced at health centers. Overall, approximately two-thirds of the facilities reported having staff that could provide parenteral anticonvulsants (Table 3). Most of the health centers reported that they had not provided anticonvulsant treatment to patients in the 3 months prior to the survey. Most anticonvulsant therapy (and, consequently, most pre-eclampsia care) seemed to have been provided at hospitals, which were relatively few in number and farther away from the populace.

3.4. Drugs and equipment

Fewer than half of the health centers had any anticonvulsants/sedatives in stock, and what they had was diazepam (Table 4). All but 1 hospital had diazepam in stock, but only 11% reported having magnesium sulfate. Although most of the hospitals had an antihypertensive in stock, very few had labetalol and only 70% had hydralazine—an antihypertensive suitable for acute hypertension control. The shortage was more severe at health centers. Nearly 25% of the hospitals had no general inhalation anesthesia (an eclamptic patient is likely to require general—rather than spinal—anesthetic for a cesarean, and ketamine may only worsen already elevated blood pressure). Standard equipment and supplies such as IV sets, blood pressure cuffs and stethoscopes, and urine dipsticks were found to be missing to varying degrees. The survey found that only 2% of the hospitals had facilities for intensive care for women with severe pre-eclampsia/eclampsia.

4. Discussion

Annually, an estimated 54 000–216 000 Ethiopian mothers are expected to have pre-eclampsia/eclampsia, based on the predicted prevalence of 2%–8% from a total 2.7 million deliveries per year [16]. The survey found that only 1%–3.8% (n=2095) of the total number of potential pre-eclamptic women received care at health facilities during the year for which the EmONC survey collected data. It is likely that the number of cases at facilities was under-recorded. However, even if the number reported were doubled, a large proportion of pre-eclampsias/eclampsias still did not access the formal health system. The implication for resultant morbidity and mortality is obvious.

The case fatality rate of 3.6% is much higher than rates reported from high-income settings, but consistent with findings from previous hospital-based studies in Ethiopia [17–21]. This high rate corroborates other findings of the assessment and indicates inadequacies in the

### Table 1

<table>
<thead>
<tr>
<th>Measure of disease burden due to PE/E</th>
<th>Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE/E cases as a proportion of total deliveries</td>
<td>2095/174,561 (1.2)</td>
</tr>
<tr>
<td>PE/E cases as a proportion of all complications</td>
<td>2095/435,870 (4.6)</td>
</tr>
</tbody>
</table>

(‘direct and indirect’)

| PE/E cases as a proportion of all direct obstetric complications | 2095/41,666 (5.0) |
| PE/E cases as a proportion of all maternal deaths | 75,685 (10.9) |
| PE/E cases as a proportion of cesarean deliveries | 16,267 (6.0) |

(‘Institutional aggregate case fatality rate due to PE/E’)

### Abbreviations: EmONC, emergency obstetric and newborn care; PE/E, pre-eclampsia/eclampsia.

a Values are given as number (percentage).

### Table 3

<table>
<thead>
<tr>
<th>Services and modalities</th>
<th>Health centers, % (n=639)</th>
<th>Hospitals, % (n=112)</th>
<th>Total, % (n=751)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midwife available with basic EmONC training</td>
<td>17.2</td>
<td>36.6</td>
<td>20.1</td>
</tr>
<tr>
<td>Doctor/clinical officer with comprehensive EmONC training available</td>
<td>7.8</td>
<td>36.6</td>
<td>12.1</td>
</tr>
<tr>
<td>Health worker able to provide focused prenatal care</td>
<td>93.7</td>
<td>92.9</td>
<td>93.6</td>
</tr>
<tr>
<td>Health worker able to provide parenteral anticonvulsants</td>
<td>63.2</td>
<td>96.4</td>
<td>68.2</td>
</tr>
<tr>
<td>Parenteral anticonvulsants/sedatives provided in the past 3 months</td>
<td>12.1</td>
<td>83.8</td>
<td>22.7</td>
</tr>
<tr>
<td>In the past 12 months</td>
<td>26.6</td>
<td>94.6</td>
<td>36.7</td>
</tr>
</tbody>
</table>

### Abbreviation: EmONC, emergency obstetric and newborn care.

### Table 4

<table>
<thead>
<tr>
<th>Drugs and supplies</th>
<th>Health centers, % (n=675)</th>
<th>Hospitals, % (n=111)</th>
<th>Total, % (n=786)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anticonvulsants/sedatives</td>
<td>46.5</td>
<td>97.3</td>
<td>53.7</td>
</tr>
<tr>
<td>Magnesium sulfate</td>
<td>1.0</td>
<td>10.8</td>
<td>2.0</td>
</tr>
<tr>
<td>Diazepam</td>
<td>90.8</td>
<td>99.8</td>
<td>91.9</td>
</tr>
<tr>
<td>Antihypertensives</td>
<td>74.8</td>
<td>99.1</td>
<td>78.2</td>
</tr>
<tr>
<td>Hydralazine</td>
<td>41.2</td>
<td>70.3</td>
<td>45.3</td>
</tr>
<tr>
<td>Labetalol</td>
<td>26.1</td>
<td>4.5</td>
<td>23.0</td>
</tr>
<tr>
<td>Methyldopa</td>
<td>97.2</td>
<td>96.4</td>
<td>97.1</td>
</tr>
<tr>
<td>Nifedipine</td>
<td>36.3</td>
<td>82.0</td>
<td>42.7</td>
</tr>
<tr>
<td>Anesthesia</td>
<td>70.2</td>
<td>97.3</td>
<td>74.0</td>
</tr>
<tr>
<td>Halothane</td>
<td>31.9</td>
<td>76.6</td>
<td>38.2</td>
</tr>
<tr>
<td>Ketamine</td>
<td>32.9</td>
<td>82.0</td>
<td>39.8</td>
</tr>
<tr>
<td>Anesthesia apparatus</td>
<td>(1 of 6)</td>
<td>79.6 (n=98)</td>
<td>79.8 (n=104)</td>
</tr>
<tr>
<td>Electric suction apparatus</td>
<td>(6 of 6)</td>
<td>95.9 (n=98)</td>
<td>96.2 (n=104)</td>
</tr>
<tr>
<td>IV set</td>
<td>56.8</td>
<td>79.5</td>
<td>60.2</td>
</tr>
<tr>
<td>BP cuff and stethoscope</td>
<td>92.2</td>
<td>96.4</td>
<td>92.8</td>
</tr>
<tr>
<td>Urine test strips</td>
<td>24.8</td>
<td>39.3</td>
<td>26.9</td>
</tr>
</tbody>
</table>

### Abbreviations: BP, blood pressure; EmONC, emergency obstetric and newborn care; IV, intravenous.

a Defined as an IV stand, giving set, IV cannulae, and some sort of IV fluid.
management of pre-eclampsia/eclampsia. The 11% contribution of pre-eclampsia/eclampsia to overall maternal mortality is comparable to Asian and African estimates of 9.1% of total maternal mortality [4]. Yet a reorganization of primary-care services in Jamaica resulted in a significant reduction in the incidence of pre-eclampsia/eclampsia. Prenatal patients were screened for hypertension and referred to prenatal clinics where pre-eclampsia/eclampsia clinical protocols had been introduced. All cases were investigated to identify problems in the system. In addition, a patient-held pictorial form reminded women of the symptoms of pre-eclampsia/eclampsia and the actions to take [22,23]. This model could be adapted in Ethiopia until such time as health center-level care is within the reach of most women.

Constraints in the availability of essential staff for the administration of parenteral anticonvulsants were identified by the survey. The number of trained staff able to administer parenteral anticonvulsants and the actual administration of the compounds in the months preceding the survey were limited, especially at health centers.

4.1. Actions taken

The Government of Ethiopia has initiated an ambitious program to increase universal availability and accessibility of primary health care to the majority of the populace. The 3 most important components are as follows:

- The number of health centers, which numbered in the hundreds as follows:
- The pharmaceutical supply chain (especially essential drugs such as magnesium sulfate at health facilities in the country. A large test strips may be a challenge because only one-quarter of health equipped with stethoscopes but supplying health posts with urine and institutional delivery care to women with obstetric complications, including those affected by pre-eclampsia/eclampsia.
- A primary healthcare approach involves a health extension program [25]. The nationwide program is implemented by remunerated community health workers whose primary role is health promotion and prevention. Their services include the provision of prenatal, clean delivery, and postnatal care at health posts, as well as outreach programs through home visits. Augmenting the training of these health extension workers (HEWs) on the detection of pre-eclampsia/eclampsia will substantially increase the ability of the health system to detect this complication. The HEWs are already equipped with stethoscopes but supplying health posts with urine test strips may be a challenge because only one-quarter of health centers had them.
- The Federal Ministry of Health, in collaboration with UNICEF and other national partners, took action to ensure the availability of magnesium sulfate at health facilities in the country. A large consignment of magnesium sulfate has been imported and distributed to all hospitals and health centers. The clinical guidelines, training and clinical mentoring, and the initiation of service are already underway. Technical support for the national effort is provided by the Ethiopian Society of Obstetricians and Gynecologists [26]. These developments are indicative of a positive response to the release of the national EmONC assessment in 2009 and of the commitment and sense of urgency by the government, and national and international partners to improve maternal and newborn health in the country.

4.2. Recommendations

- Capacity for referral should be improved by assuring the availability of appropriate clinical protocols for stabilization and ambulances for referral to higher levels of care at all health facilities providing maternity care because timely referral of eclamptic mothers could be difficult through other means of transportation.
- The availability of urine test strips, anticonvulsants, and antihypertensives should be assured at all facilities providing obstetric care. This includes health centers and clinics at which primary care is provided. The drug of choice for controlling eclamptic seizures and for treating severe pre-eclampsia is magnesium sulfate, which has proven superiority over diazepam and other anticonvulsants.
- The pharmaceutical supply chain (especially essential drugs such as antihypertensives and anesthetics) should be regularly monitored with regard to availability in all facilities, including primary-care settings. The unavailability of these essential and often relatively cheap drugs may be due to a lack of regular monitoring by responsible national agencies rather than cost-related issues. Essential drugs should receive special focus and attention in the overall national pharmaceutical availability, supply, and monitoring processes.
- The assessment revealed limitations within the health facilities regarding readiness to diagnose and manage this complication. Improvements in health services through addressing the areas of concern highlighted above—in conjunction with the expansion of health facilities currently underway—are expected to lead to gradual improvements in care and outcome. However, it is also necessary to consider interim strategies that will augment the health system response in addressing the unmet healthcare needs of women with pre-eclampsia/eclampsia. Possible actions in this regard include increasing the role of community health workers in the diagnosis and initiation of management of pre-eclampsia/eclampsia and increasing community awareness on the recognition of signs and symptoms of the condition and appropriate care-seeking behaviors.
- Some authors have indicated that a single injection of intramuscular magnesium sulfate can serve to control eclampsia until referral to a higher facility. In cases in which referral is not possible, such management could also improve outcome. The possibility of task sharing or shifting the administration of this drug to cadres such as HEWs is an area of focus for future operations research [27].
- Community education on the importance of blood pressure measurement during pregnancy can sensitize mothers and their families to pre-eclampsia. Education should focus on the importance of screening for hypertension, knowledge of symptoms (e.g., headaches, visual disturbances, and generalized edema), and need for prompt actions if seizures occur. The HEWs are strategically placed to pass such important information to the community. The costs of patient-held cards could be offset by reductions in the more costly care of pre-eclampsia/eclampsia and other life-threatening complications. Other modalities of health promotion, including mass media and mobile technology, could also be utilized to sensitize the community.
- Why so few of the potential pre-eclamptic population accessed available services must be the focus of future studies. The contribution of user fees, access to and quality of care, and sociocultural barriers to service utilization should be investigated to identify potential barriers to care. Health system strengthening alone may not be sufficient for increasing service utilization and improving maternal outcomes—certainly not as quickly as system-strengthening efforts coupled with community education and mobilization, and improving access.

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Conflict of interest

The authors have no conflicts of interest.

References


