Access to key maternal health services in north-central Liberia

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STRUCTURED ABSTRACT

Objective: Rural north-central Liberia has one of the world's highest maternal mortality ratios. We studied health facility birthing service utilization and the motives of women seeking or not seeking facility-based care in north-central Liberia.

Design: Cross-sectional community-based structured interviews and health facility medical record review.

Setting: A regional hospital and the surrounding communities in rural north-central Liberia.

Participants: A convenience sample of 307 women between 15-49 years participated in structured interviews. 1031 deliveries performed in the regional hospital were included in the record review.

Primary outcomes: Delivery within a health facility and cesarean delivery rates were used as indicators of direct utilization of care and as markers of availability of maternal health services.

Results: Of 280 interview respondents with a prior childbirth, only 47 (16.8%) delivered their last child in a health facility. Women who did not use formal services cited cost, sudden labor, and family tradition or religion as their principal reasons for home delivery. At the regional hospital, the cesarean delivery rate was 35.5%. Major indications included cephalopelvic disproportion (50.0%) and antepartum hemorrhage (10.2%).

Conclusions: There is an enormous unmet need for maternal health services in north-central Liberia. Greater outreach and referral services as well as community-based education among women, family members, and traditional birth attendants are vital to improve the timely utilization of care.

INTRODUCTION

In 2008 an estimated 342,900 women died in childbirth worldwide.[1] A vast global disparity exists, with more than 99% of maternal deaths taking place in low and middle-income countries (LMIC). The maternal mortality ratio (MMR) represents the number of maternal deaths per 100,000 live births. MMR has decreased in Asia and Latin America in the past two decades, but has remained near-constant in sub-Saharan Africa.[1,2] According to the World Health Organization (WHO), most maternal deaths could be prevented with ready access to adequate obstetric services.[3,4] Millennium Development Goal 5 calls for a three-quarters reduction in MMR globally by 2015. Strides have been made toward this target; however, large-scale international programs have not reduced maternal mortality significantly in areas of the world that bear the greatest burden.[1,5,6]

Programs to reduce maternal mortality must consider the local context of maternal mortality and access to maternal health services if they are to be effective.[6-8] Recent efforts to improve the measurement of maternal mortality globally have yielded more accurate and complete data.[1] Still, there is a paucity of primary community information in many countries with the highest MMR, such as Liberia.[1,9-11] In addition, a high degree of variability in MMR and access to maternal care exists within communities.[12,13]

In areas with high maternal mortality and poor information systems, process indicators can be highly informative to evaluate the unmet need for maternal health care. Direct measurement of service delivery includes the proportion of women who deliver in a health facility under skilled attendance and the rate of cesarean delivery.[14-16] These indicators are easier to capture than MMR partly because maternal death is difficult to ascertain, especially in rural areas, or may occur in small catchment areas with low numbers over a short evaluation timespan.[17]

Liberia was the setting for our study and is among the poorest countries in the world; it has one of the ten highest national MMR of any nation.[18] Hogan and colleagues estimated MMR in Liberia to be 859 (uncertainty interval, 547-1287) maternal deaths per 100,000 live births in 2008.[1] By comparison, the MMR in Ghana, among the lowest in the region, was 409 (248-633), and in neighbor Sierra Leone, it was 1033 (635-1627), the region's highest. The wide uncertainty intervals are reflective of the relative lack of data captured by poor health information systems in Liberia, which is still recovering from a 14-year civil war that ended in 2003. Health infrastructure and human resources were decimated during that span. In 2009, the country was estimated to have a deficit of 10,000 health care workers.[19] The 2009 World Health Statistics report confirms a corresponding gap in access to essential services, citing only 46% of women in Liberia deliver under skilled attendance in health facilities.[20] In addition, the national cesarean delivery rate in 2007 was 3.5%, and <1.0% in rural parts of the country.[12,20] As Liberia rebuilds its health infrastructure and targets maternal mortality, community-level research is needed to appropriately direct maternal health interventions.[21]

The objective of this study was to characterize utilization of maternal health services, including facility delivery and cesarean delivery, in rural north-central Liberia and describe the motives of women seeking or not seeking facility-based care.

METHODS

We conducted a cross-sectional study employing a structured interview in a community setting, as well as a review of medical records at the local hospital. The individual structured interview comprised of questions on the behavior and attitudes of women regarding maternal health care. Eight communities were chosen based on the presence of existing outreach programs for a regional hospital in Nimba County, located in north-central Liberia. All communities were within

15 km of the hospital. More than 95% of the county's 462,000 residents live in a rural setting.[12]

All women between the ages of 15-49 years were eligible, consonant with age sampling of the 2007 Liberia Demographic and Health Survey.[12] Women were approached for participation in their homes. All households in each village were visited once, resulting in a convenience sample given absenteeism. Community health workers were trained to conduct 25-minute standardized interviews. Questions in English were designed in collaboration with clinicians, public health technicians, and community health workers in Liberia. Interviews were conducted orally in English or Mano, a language spoken in the region, as per a participant's preference. The interviewers were trained to record responses including multiple answers given to open-ended questions. Responses were coded by a member of the research team. Verbal informed consent was obtained from all participants. Women received a small non-monetary compensation (value≈US$2) for their time.

The review of medical records involved a retrospective evaluation of all deliveries at a regional hospital in Nimba County using general medical and operating room records. Data were extracted on method of delivery, incidence of stillbirth, and maternal and fetal indications for cesarean delivery. Extraction was performed by a hospital data officer and a medical student.

Statistical analysis

Participant responses were analyzed for frequencies, means, and standard deviations as indicated. Participant characteristics were correlated with their interview responses. Nulliparous women were excluded from analysis of questions related to prior pregnancies. Fisher's exact test was used to evaluate categorical variables and Student's T-test was used for continuous

variables. Our primary outcomes of interest were facility delivery rate assessed in the community and Cesarean delivery rate in a regional hospital.

Data were kept anonymous at all times by removing all identifiers. Ethical approval was granted by the Vanderbilt University Institutional Review Board, and the Medical Director of the Liberian hospital.

RESULTS

Between May 2009 and August 2009, 316 women were approached to participate in community interviews. Of these 307 (97.2%) met eligibility criteria, consented, and completed the interview. Participants had a mean age of 30.5 (SD±7.5)(Table 1). The median parity was 4.8 (SD±3.0). More than half (n=174, 57.1%) of women reported having no formal education. Of 280 women who reported previous parity, 210 (75.0%) reported delivering their previous child at home with a traditional birth attendant (TBA) and 23 (8.2%) at home without a TBA. Interviewers then asked, "Why did you choose to deliver your child in this place?" Responses for those delivering at home included, 'cost' or 'difficulty with transport' (31.5%), 'quick onset of labor' (30.6%), 'family tradition' or 'religion' (16.9%), 'TBA is safe' (16.9%), and 'conflict' or 'flooding' (3.7%). Women who reported delivering in a hospital responded, 'labor complications at home' (57.8%), 'hospital nearby' (13.3%), 'antenatal referral' (11.1%) 'safety' (11.1%), and 'previous cesarean delivery' (6.7%).

In women who reported delivering at home, and those who reported delivering in a hospital, there was no statistical evidence to suggest a difference in age, parity, relationship status, or whether a woman reporting losing a child during a previous pregnancy (Table 2). Women who reported delivering at home were less likely to have education at or beyond the primary level, a result that had borderline statistical significance (p=0.057).

In a 1-year period between April 2008-March 2009, 949 live births occurred in the study hospital. In the same period, 82 stillbirths were recorded, 8.0% of total births (n=1031). The rate of cesarean delivery at the hospital was 35.5% (n=337). The stillbirth rate in the cesarean subset was 12.4%. Common indications for cesarean delivery included cephalopelvic disproportion (50.0%), previous cesarean delivery (12.7%), antepartum hemorrhage due to placenta previa or placental abruption (10.2%), eclampsia (8.5%), breech presentation (5.0%), and ruptured uterus (4.2%).

DISCUSSION

In structured interviews conducted in villages proximate to a hospital in Nimba County, Liberia, only one in six women reported delivering their last child in a hospital, i.e., 83.2% of women reported their last delivery to have been at home. Of women delivering at a regional hospital, 35.5% were by cesarean section and 8.0% were stillborn. These metrics indicate severe underutilization of timely, supervised, institutional birthing services among women in north-central Liberia. Participants reported financial and transportation barriers to seeking care, as well as cultural traditions including the practice of delivery under the care of TBA. Further, more than half of women who delivered their last child in a hospital did do so only after experiencing complications in labor at home. This was validated by the hospital's high cesarean section rate. These findings are similar to those of a 2011 study in the same region of Liberia that highlighted the impact of geographic and financial barriers, perceptions of quality in the formal and informal health care systems, and prevailing care by TBAs on the health care utilization.[22]

The rates of hospital delivery in our study were significantly lower than the national (46.3%) and county (32.6%) statistics reported in 2007 for skilled attendance at delivery, a related metric used by the WHO and Liberia Ministry of Health to assess women's access to safe maternal

health services.[3,12] Skilled attendance differs from facility delivery in the requirement of supervision of childbirth by a physician, nurse, trained midwife or physician's assistant.[10] This is deemed vital to the early recognition of life-threatening intrapartum complications, and their effective management.[4,14] While hospital delivery is a prerequisite for skilled attendance in Liberia where home deliveries are rarely supervised by a professional in the above cadres, it is not necessarily true that all hospital deliveries have the appropriate personnel present. Therefore, our measured rates of facility delivery potentially overestimate the true figure for safe delivery under skilled attendance among the participants.

The definition for skilled attendants notably excludes TBAs because they do not have access to resources for medical or surgical management of labor.[3] Women under TBA care who have conditions such as dystocia, eclampsia, or bleeding are exceedingly vulnerable. In addition, TBAs have limited training in the recognition of complications, and in the study community there were no formal mechanisms for timely referral if complications arose.[9] Actually, only 16.9% believed that a delivery with a TBA was safe, a finding similar to a previous study in east Africa.[23]

When we compared women who delivered their last child at home to those who delivered in a hospital, only education differed; home-delivered women were more likely to report having no formal education. Previous studies have demonstrated the alarming inequalities in access to maternal health care based on education levels, as well as wealth, rurality, and religion.[6,13,24]

In our review of hospital medical and operating room records we found that cesarean delivery accounted for more than a third of all deliveries, though there were relatively few births at the facility in the study period. The hospital serves a region of approximately 250,000 people where nearly 10,000 births were expected annually.[12] While smaller health facilities may provide

services in a portion of these births, the delivery number at the study site is still very low and reflects the trend toward home delivery found in interviews.

In addition, the high rate of cesarean delivery may stem from referral of complicated cases from other facilities and late presentation after attempted home delivery.[25,26] Prolonged labor, antepartum hemorrhage, and ruptured uterus were the common antecedents to cesarean delivery.[27] Unfortunately, we were not able to ascertain the duration of labor, location where labor was initiated, and delays in accessing care. Prior research in the region using the "three-delays" model found significant delays at all three stages — deciding to seek care, reaching a health facility, and receiving needed care at the facility.[9,25] These prior studies similarly highlighted the importance of family and TBA influence on timely access to care.

Cesarean delivery is cited as a life-saving component of Comprehensive Emergency Obstetric Care (EmOC).[16] Criteria for Comprehensive EmOC include 24-hour cesarean delivery and blood transfusion availability, standards not met by this regional hospital.[28] Obstacles to the delivery of Comprehensive EmOC included human resource shortages, intermittent electricity supplied exclusively by generator, and scarcity of donated blood that often necessitated donations from the patient's family at the time of the operation.

Limitations of our study included non-randomized sampling of participants in community interviews. In fact, convenience recruitment in proximate communities with active hospital outreach programs may have over-represented "health-seekers" and women with access to hospital services, or skewed the sample population in unknown ways by excluding women who were not at home when interviewers visited. Additionally, the hospital-based portion of our study was limited by poor data quality, particularly pertaining to "history of the present illness,"

a key timeline necessary to evaluate the dynamic causes of birth complications in the context of home- and facility-delivery.

The combination of community and facility data enabled us to report on deficiencies in the utilization of maternal health services in north-central Liberia. Many women in need of such services did not access them, even if care was available locally. Additionally, there was a high rate of serious complications among women presenting to the hospital for cesarean delivery. Greater outreach and referral services as well as education among women and traditional birth attendants are needed to improve timely utilization of care. Our study also highlights the importance of performing local assessments of maternal health services to inform policy and programmatic interventions at the community level.

Table 1. Interview responses of women (n=307)* interviewed in their homes in rural northern Liberia in 2010

Characteristic	Value
Age, mean years (SD)	30.5 (7.5)
Parity, mean no. (SD)	4.8 (3.0)
Education level, no. (%)	
No formal education	174 (57.1)
Some primary	114 (37.4)
Completed primary or greater	17 (5.6)
Relationship status, no. (%)	
Married	223 (72.6)
Unmarried	84 (27.4)
Lost a child during pregnancy, no. (%)	
Yes	113 (37.0)
No	192 (63.0)
Last child delivered, no. (%)†	
In hospital	47 (16.8)
At home with traditional midwife (TM)	210 (75.0)
At home without TM	23 (8.2)
Why did you choose to deliver your child in this place?†	
Home, no. (%)	
'Cost' or 'Difficulty with transport'	69 (31.5)
'Quick onset of labor'	67 (30.6)

‘Family tradition’ or ‘Religion’	37 (16.9)
‘TM is safe’	37 (16.9)
‘Conflict’ or ‘Flooding’	8 (3.7)
Hospital, no. (%)	
‘Labor complications at home’	26 (57.8)
‘Hospital nearby’	6 (13.3)
‘Antenatal referral’	5 (11.1)
‘Hospital is safer’	5 (11.1)
‘Previous Cesarean delivery’	3 (6.7)

* Totals may not add to 307 due to missing values.

† N=280 excluding nulliparous women

Table 2. Comparison of characteristics of rural Liberian women who reported delivering their last child at home or in hospital, excluding nulliparous women (n=280)

Characteristic	HOME	HOSPITAL	P-value
Age, mean years (SD)	30.9 (7.3)	29.6 (8.3)	0.29
Parity, mean no. (SD)	4.9 (2.9)	4.5 (3.2)	0.32
Education level, no. (%)			
None	139 (59.9)	20 (43.5)	0.057
Some primary	84 (36.2)	22 (47.8)	
Completed primary or greater	9 (3.9)	4 (8.7)	
Relationship status, no. (%)			
Married	168 (72.1)	33 (70.2)	0.86
Unmarried	65 (27.9)	14 (29.8)	
Lost a child during pregnancy or childbirth, no. (%)			
Yes	86 (36.9)	18 (38.3)	0.87
No	147 (63.1)	29 (61.7)	

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Access to facility delivery and caesarean section in north-central Liberia: a cross-sectional community-based study

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Abstract:

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Design: Cross-sectional community-based structured interviews and health facility medical record review.

Setting: A regional hospital and the surrounding communities in rural north-central Liberia.

Participants: A convenience sample of 307 women between 15-49 years participated in structured interviews. 1031 deliveries performed in the regional hospital were included in the record review.

Primary outcomes: Delivery within a health facility and cesarean delivery rates were used as indicators of direct utilization of care and as markers of availability of maternal health services.

Results: Of 280 interview respondents with a prior childbirth, only 47 (16.8%) delivered their last child in a health facility. Women who did not use formal services cited cost, sudden labor, and family tradition or religion as their principal reasons for home delivery. At the regional hospital, the cesarean delivery rate was 35.5%.

Conclusions: There is an enormous unmet need for maternal health services in north-central Liberia. Greater outreach and referral services as well as community-based education among women, family members, and traditional midwives are vital to improve the timely utilization of care.

INTRODUCTION

In 2008 an estimated 342,900 women died in childbirth worldwide.[1] A vast global disparity exists, with more than 99% of maternal deaths taking place in low and middle-income countries (LMIC). The maternal mortality ratio (MMR) represents the number of maternal deaths per 100,000 live births. MMR has decreased in Asia and Latin America in the past two decades, but has remained near-constant in sub-Saharan Africa.[1-3] According to the World Health Organization (WHO), most maternal deaths could be prevented with ready access to adequate obstetric services.[4,5] Millennium Development Goal 5 calls for a three-quarters reduction in MMR globally by 2015. Strides have been made toward this target; however, large-scale international programs have not reduced maternal mortality significantly in areas of the world that bear the greatest burden.[1,6,7]

Programs to reduce maternal mortality must consider the local context of maternal mortality and access to maternal health services if they are to be effective.[7-9] Recent efforts to improve the measurement of maternal mortality globally have yielded more accurate and complete data.[1] Still, there is a paucity of primary community information in many countries with the highest MMR, such as Liberia.[1,3,10,11] In addition, a high degree of variability in MMR and access to maternal care exists within communities.[12,13]

In areas with high maternal mortality and poor information systems where data on maternal mortality are not available, process indicators related to this outcome can be highly informative to evaluate the unmet need for maternal health care. Process indicators for maternal mortality include the proportion of women who deliver in a health facility under skilled attendance and the rate of cesarean delivery.[14-16] These indicators are easier to capture partly because

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The objective of this study was to characterize utilization of maternal health services, including facility delivery and cesarean delivery, in rural north-central Liberia and describe the motives of women seeking or not seeking facility-based care.

METHODS

We conducted a cross-sectional study employing a structured interview in a community setting, as well as a review of medical records at the local hospital. The individual structured interview comprised of questions on the behavior and attitudes of women regarding maternal health care.

Eight communities were chosen based on the presence of existing outreach programs for antenatal education and childhood immunizations for a regional hospital in Nimba County, located in north-central Liberia. All communities were within 15 km of the hospital. More than 95% of the county's 462,000 residents live in a rural setting.[12]

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Statistical analysis

Participant responses were analyzed for frequencies, means, and standard deviations as indicated. Participant characteristics were correlated with their interview responses. Nulliparous

women were excluded from analysis of questions related to prior deliveries. Respondents with missing data were dropped from all analyses. Fisher's exact test was used to evaluate categorical variables and Student's T-test was used for continuous variables. All analyses were performed with SAS version 9.1.3 (SAS Institute, Cary, NC). Our primary outcomes of interest were facility delivery rate assessed in the community and cesarean delivery rate in a regional hospital.

Data were kept anonymous at all times by removing all identifiers. Ethical approval was granted by the Vanderbilt University Institutional Review Board, and the Medical Director of the Liberian hospital.

RESULTS

Between May 2009 and August 2009, 316 women were approached to participate in community interviews. Of these 307 (97.2%) met eligibility criteria, consented, and completed the interview. There was 1 (0.3%) documented refusal. Participants had a mean age of 30.5 (SD±7.5)(Table 1). The mean parity was 4.8 (SD±3.0). More than half (n=174, 57.1%) of women reported having no formal education. There were 6 (2.0%) nulliparous women and 21 (6.8%) who chose not to answer questions regarding the site of delivery in the immediate prior pregnancy. Of the remaining 280 women, 210 (75.0%) reported delivering their previous child at home with a traditional midwife (TM) and 23 (8.2%) at home without a TM. Interviewers then asked the open-ended question, "Why did you choose to deliver your child in this place?" for which multiple responses were accepted. Responses for those delivering at home included, 'cost' or 'difficulty with transport' (31.5%), 'quick onset of labor' (30.6%), 'family tradition' or 'religion' (16.9%), 'TM is safe' (16.9%), and 'conflict' or 'flooding' (3.7%). Women who reported delivering

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DISCUSSION

In structured interviews conducted in villages proximate to a hospital in Nimba County, Liberia, only one in six women reported delivering their last child in a hospital, i.e., 83.2% of women reported their last delivery to have been at home. Of women delivering at a regional hospital, 35.5% were by cesarean section and 8.0% were stillborn. These metrics indicate severe underutilization of timely, supervised, institutional birthing services among women in north-central Liberia. Participants reported financial and transportation barriers to seeking care, as well as cultural traditions including the practice of delivery under the care of a TM. (Traditional midwife is the term used in Liberia, analogous to the traditional birth attendant in other

nations.) Further, more than half of women who delivered their last child in a hospital did do so only after experiencing complications in labor at home. This was validated by the hospital's high cesarean section rate. These findings of underutilization of the formal health sector are similar to those of a 2011 study in the same region of Liberia that highlighted the impact of geographic and financial barriers, perceptions of quality in the formal and informal health care systems, and prevailing care by informal health workers, including TM, on the health care utilization.[21]

The rates of hospital delivery in our study were significantly lower than the national (46.3%) and county (32.6%) statistics reported in 2007 for skilled attendance at delivery, a related metric used by the WHO and Liberia Ministry of Health to assess women's access to safe maternal health services.[4,12] Skilled attendance differs from facility delivery in the requirement of supervision of childbirth by a physician, nurse, trained midwife or physician's assistant.[11] This is deemed vital to the early recognition of life-threatening intrapartum complications, and their effective management.[5,14] While hospital delivery is a prerequisite for skilled attendance in Liberia where home deliveries are rarely supervised by a professional in the above cadres, it is not necessarily true that all hospital deliveries have the appropriate personnel present. Therefore, our measured rates of facility delivery potentially overestimate the true figure for safe delivery under skilled attendance among the participants.

The definition for skilled attendants notably excludes TM because they do not have access to resources for medical or surgical management of labor.[4] Women under TM care who have conditions such as dystocia, eclampsia, or bleeding are exceedingly vulnerable. In addition, TM have limited training in the recognition of complications, and in the study community there were no formal mechanisms for timely referral if complications arose.[10]

When we compared women who delivered their last child at home to those who delivered in a hospital, only education differed; home-delivered women were more likely to report having no formal education. Previous studies have demonstrated the alarming inequalities in access to maternal health care based on education levels, as well as wealth, rural venue, and religion.[7,13,22]

In our review of hospital medical and operating room records we found that cesarean delivery accounted for more than a third of all deliveries, though there were relatively few births at the facility in the study period. The hospital serves a region of approximately 250,000 people where nearly 10,000 births were expected annually.[12] Additionally it is the only facility within a 35km radius with capacity to provide cesarean delivery service. While smaller health facilities in the region equipped to offer assisted vaginal delivery may provide services in a portion of births in the catchment area, the delivery number at the study site is still very low and reflects the trend toward home delivery found in interviews.

In addition, the high rate of cesarean delivery may stem from referral of complicated cases from other facilities and late presentation after attempted home delivery.[23,24] Prolonged labor, antepartum hemorrhage, and ruptured uterus were the common antecedents to cesarean delivery.[25] Unfortunately, we were not able to ascertain the duration of labor, location where labor was initiated, and delays in accessing care. Prior research in the region using the “three-delays” model found significant delays at all three stages — deciding to seek care, reaching a health facility, and receiving needed care at the facility.[10,23] These prior studies similarly highlighted the importance of family and TM influence on timely access to care.

Cesarean delivery is cited as a life-saving component of Comprehensive Emergency Obstetric Care (EmOC).[16] Criteria for Comprehensive EmOC include 24-hour cesarean delivery and blood

transfusion availability.[26] Notably, these standards were not met by this regional hospital. Typical obstacles to the delivery of Comprehensive EmOC in the region include human resource shortages, intermittent electricity supplied exclusively by generator, and scarcity of donated blood that often necessitates donations from the patient's family at the time of the operation.

Limitations of our study included non-randomized sampling of participants in community interviews. In fact, convenience recruitment in proximate communities with active hospital outreach programs in maternal and child health may have over-represented "health-seekers" and women with access to hospital services, or skewed the sample population in unknown ways by excluding women who were not at home when interviewers visited. Unfortunately we do not have data from communities without hospital outreach programs for comparison. In addition, refusal to participate among women approached was not documented consistently by survey administrators so we are unable to accurately report on this figure. Finally, the hospital-based portion of our study was limited by poor medical record keeping and organization, and missing data, particularly pertaining to "history of present illness," a key timeline necessary to evaluate the dynamic causes of birth complications in the context of home- and facility-delivery.

In summary, the combination of community and facility data enabled us to identify deficiencies in the utilization of maternal health services in north-central Liberia. Many women in need of such services did not access them, even if care was available locally. Additionally, there was a high rate of serious complications among women presenting to the hospital for cesarean delivery. Greater outreach and referral services as well as education among women and TM are needed to improve timely utilization of care. Our study also highlights the importance of performing local assessments of maternal health services in order to accurately measure community needs that otherwise may be underestimated by national surveys. These

geographically focused evaluations are critical to inform policy and programmatic interventions at the community level.

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CONTRIBUTORSHIP:

All authors were involved in the design of the study, the analysis of data, and the writing and editing of this paper. MGG conducted interviews with participants. All authors had full access to all the data in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis. MGG wrote the first draft of the paper, and all authors made important intellectual contributions to the content and approved the final version.

COMPETING INTERESTS:

There are no competing interests .

DATA SHARING STATEMENT:

There is no additional unpublished data available.

Table 1. Interview responses of women (n=307)* interviewed in their homes in rural northern Liberia in 2010

Characteristic	Value
Age*, mean years (SD)	30.5 (7.5)
Parity*, mean no. (SD)	4.8 (3.0)
Education level, no. (%)	
No formal education	174 (57.1)
Some primary	114 (37.4)
Completed primary or greater	17 (5.6)
Relationship status, no. (%)	
Married	223 (72.6)
Unmarried	84 (27.4)
Lost a child during prior pregnancy, no. (%)	
Yes	113 (37.0)
No	192 (63.0)
Site of delivery in immediate prior pregnancy, no. (%)†	
Hospital	47 (16.8)
Home with traditional midwife (TM)	210 (75.0)
Home without TM	23 (8.2)
Why did you choose to deliver your child in this place?†	
Home, no. (%)	
'Cost' or 'Difficulty with transport'	69 (31.5)
'Quick onset of labor'	67 (30.6)

‘Family tradition’ or ‘Religion’	37 (16.9)
‘TM is safe’	37 (16.9)
‘Conflict’ or ‘Flooding’	8 (3.7)
Hospital, no. (%)	
‘Labor complications at home’	26 (57.8)
‘Hospital nearby’	6 (13.3)
‘Antenatal referral’	5 (11.1)
‘Hospital is safer’	5 (11.1)
‘Previous Cesarean delivery’	3 (6.7)

* Totals may not add to 307 due to missing values. 280 respondents reported age. 305 respondents reported parity.
† N=280 excluding nulliparous women

Table 2. Comparison of characteristics of rural Liberian women who reported delivering their last child at home or in hospital, excluding nulliparous women (n=280)

Characteristic	HOME	HOSPITAL	P-value
Age, mean years (SD)	30.9 (7.3)	29.6 (8.3)	0.29
Parity, mean no. (SD)	4.9 (2.9)	4.5 (3.2)	0.32
Education level, no. (%)			
None	139 (59.9)	20 (43.5)	0.057
Some primary	84 (36.2)	22 (47.8)	
Completed primary or greater	9 (3.9)	4 (8.7)	
Relationship status, no. (%)			
Married	168 (72.1)	33 (70.2)	0.86
Unmarried	65 (27.9)	14 (29.8)	
Lost a child during prior pregnancy, no. (%)			
Yes	86 (36.9)	18 (38.3)	0.87
No	147 (63.1)	29 (61.7)	

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INTRODUCTION

In 2008 an estimated 342,900 women died in childbirth worldwide.[1] A vast global disparity exists, with more than 99% of maternal deaths taking place in low and middle-income countries (LMIC). The maternal mortality ratio (MMR) represents the number of maternal deaths per 100,000 live births. MMR has decreased in Asia and Latin America in the past two decades, but has remained near-constant in sub-Saharan Africa.[1-3] According to the World Health Organization (WHO), most maternal deaths could be prevented with ready access to adequate obstetric services.[4,5] Millennium Development Goal 5 calls for a three-quarters reduction in MMR globally by 2015. Strides have been made toward this target; however, large-scale international programs have not reduced maternal mortality significantly in areas of the world that bear the greatest burden.[1,6,7]

Programs to reduce maternal mortality must consider the local context of maternal mortality and access to maternal health services if they are to be effective.[7-9] Recent efforts to improve the measurement of maternal mortality globally have yielded more accurate and complete data.[1] Still, there is a paucity of primary community information in many countries with the highest MMR, such as Liberia.[1,3,10,11] In addition, a high degree of variability in MMR and access to maternal care exists within communities.[12,13]

In areas with high maternal mortality and poor information systems where data on maternal mortality are not available, process indicators related to this outcome can be highly informative to evaluate the unmet need for maternal health care. Process indicators for maternal mortality include the proportion of women who deliver in a health facility under skilled attendance and the rate of cesarean delivery.[14-16] These indicators are easier to capture partly because maternal death is difficult to ascertain, especially in rural areas, or may occur in small catchment

areas with low numbers over a short evaluation timespan.[17] ~~Direct measurement of service delivery includes the proportion of women who deliver in a health facility under skilled attendance and the rate of cesarean delivery.[15-17] These indicators are easier to capture than MMR partly because maternal death is difficult to ascertain, especially in rural areas, or may occur in small catchment areas with low numbers over a short evaluation timespan.[17]~~

Liberia ~~was the setting for our study and~~ is among the poorest countries in the world; it has one of the ten highest national MMR of any nation.[18] Hogan and colleagues estimated MMR in Liberia to be 859 (uncertainty interval, 547-1287) maternal deaths per 100,000 live births in 2008.[1] By comparison, the MMR in Ghana, among the lowest in the region, was 409 (248-633), and in neighbor Sierra Leone, it was 1033 (635-1627), the region's highest. The wide uncertainty intervals are reflective of the relative lack of data captured by poor health information systems in Liberia, which is still recovering from a 14-year civil war that ended in 2003. Health infrastructure and human resources were decimated during that span. In 2009, the country was estimated to have a deficit of 10,000 health care workers.[19] The 2007 Liberia Demographic and Health Survey ~~2009 World Health Statistics report~~ confirms a corresponding gap in access to essential services, citing only 46% of women in Liberia deliver under skilled attendance in health facilities.[12]~~[20]~~ In addition, the national cesarean delivery rate in 2007 was 3.5%, and <1.0% in rural parts of the country.[12,20] As Liberia rebuilds its health infrastructure and targets maternal mortality, community-level research is needed to appropriately direct maternal health interventions. ~~[21]~~

The objective of this study was to characterize utilization of maternal health services, including facility delivery and cesarean delivery, in rural north-central Liberia and describe the motives of women seeking or not seeking facility-based care.

METHODS

We conducted a cross-sectional study employing a structured interview in a community setting, as well as a review of medical records at the local hospital. The individual structured interview comprised of questions on the behavior and attitudes of women regarding maternal health care. Eight communities were chosen based on the presence of existing outreach programs for antenatal education and childhood immunizations for a regional hospital in Nimba County, located in north-central Liberia. All communities were within 15 km of the hospital. More than 95% of the county's 462,000 residents live in a rural setting.[12]

All women between the ages of 15-49 years were eligible, consonant with age sampling of the 2007 Liberia Demographic and Health Survey.[12] Women were approached for participation in their homes or in other public spaces such as community meeting places. All households and public locations in each village were visited once, resulting in a convenience sample given absenteeism. Community health workers were trained to conduct 25-minute standardized interviews. Questions in English were designed in collaboration with clinicians, public health technicians, and community health workers in Liberia. Interviews were conducted orally in English or Mano, a language spoken in the region, as per a participant's preference. The interviewers were trained to record responses including multiple answers given to open-ended questions. Responses were coded by a member of the research team. Verbal informed consent was obtained from all participants. Women received a small non-monetary compensation (value≈US$2) for their time.

The review of medical records involved a retrospective evaluation of all deliveries at a regional hospital in Nimba County using general medical and operating room records. Data were

extracted on method of delivery, incidence of stillbirth, and maternal and fetal indications for cesarean delivery. Extraction was performed by a hospital data officer and a medical student.

Statistical analysis

Participant responses were analyzed for frequencies, means, and standard deviations as indicated. Participant characteristics were correlated with their interview responses. Nulliparous women were excluded from analysis of questions related to prior ~~pregnancies~~deliveries. Respondents with missing data were dropped from all analyses. Fisher's exact test was used to evaluate categorical variables and Student's T-test was used for continuous variables. All analyses were performed with SAS version 9.1.3 (SAS Institute, Cary, NC). Our primary outcomes of interest were facility delivery rate assessed in the community and c~~C~~esarean delivery rate in a regional hospital.

Data were kept anonymous at all times by removing all identifiers. Ethical approval was granted by the Vanderbilt University Institutional Review Board, and the Medical Director of the Liberian hospital.

RESULTS

Between May 2009 and August 2009, 316 women were approached to participate in community interviews. Of these 307 (97.2%) met eligibility criteria, consented, and completed the interview. There was 1 (0.3%) documented refusal. Participants had a mean age of 30.5 (SD±7.5)(Table 1). The ~~median~~ mean parity was 4.8 (SD±3.0). More than half (n=174, 57.1%) of women reported having no formal education. There were 6 (2.0%) nulliparous women and 21 (6.8%) who chose not to answer questions regarding the site of delivery in the immediate prior pregnancy. Of the remaining 280 women, ~~who reported previous parity,~~ 210 (75.0%) reported delivering their

previous child at home with a traditional ~~birth attendant~~midwife (~~TBA~~TM) and 23 (8.2%) at home without a ~~TBA~~TM. Interviewers then asked the open-ended question, "Why did you choose to deliver your child in this place?" for which multiple responses were accepted. Responses for those delivering at home included, 'cost' or 'difficulty with transport' (31.5%), 'quick onset of labor' (30.6%), 'family tradition' or 'religion' (16.9%), '~~TBA~~ TM is safe' (16.9%), and 'conflict' or 'flooding' (3.7%). Women who reported delivering in a hospital responded, 'labor complications at home' (57.8%), 'hospital nearby' (13.3%), 'antenatal referral' (11.1%) 'safety' (11.1%), and 'previous cesarean delivery' (6.7%).

In women who reported delivering at home, and those who reported delivering in a hospital, there was no statistical evidence to suggest a difference in age, parity, relationship status, or whether a woman reporting losing a child during a ~~previous~~ prior pregnancy (Table 2). Women who reported delivering at home were less likely to have education at or beyond the primary level, a result that had borderline statistical significance (p=0.057).

In a 1-year period between April 2008-March 2009, 949 live births occurred in the study hospital. In the same period, 82 stillbirths were recorded, 8.0% of total births (n=1031). The rate of cesarean delivery at the hospital was 35.5% (n=337). The stillbirth rate in the cesarean subset was 12.4%. Common indications for cesarean delivery included cephalopelvic disproportion (50.0%), previous cesarean delivery (12.7%), antepartum hemorrhage due to placenta previa or placental abruption (10.2%), eclampsia (8.5%), breech presentation (5.0%), and ruptured uterus (4.2%).

DISCUSSION

In structured interviews conducted in villages proximate to a hospital in Nimba County, Liberia, only one in six women reported delivering their last child in a hospital, i.e., 83.2% of women

reported their last delivery to have been at home. Of women delivering at a regional hospital, 35.5% were by cesarean section and 8.0% were stillborn. These metrics indicate severe underutilization of timely, supervised, institutional birthing services among women in north-central Liberia. Participants reported financial and transportation barriers to seeking care, as well as cultural traditions including the practice of delivery under the care of a ~~a TBA~~TM. (Traditional midwife is the term used in Liberia, analogous to the traditional birth attendant in other nations.) Further, more than half of women who delivered their last child in a hospital did do so only after experiencing complications in labor at home. This was validated by the hospital's high cesarean section rate. These findings of underutilization of the formal health sector are similar to those of a 2011 study in the same region of Liberia that highlighted the impact of geographic and financial barriers, perceptions of quality in the formal and informal health care systems, and prevailing care by ~~TBAs~~ informal health workers, including TM, on the health care utilization.[21]

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In summary,~~In summary, t~~T the combination of community and facility data enabled us to identify ~~report on~~ deficiencies in the utilization of maternal health services in north-central Liberia. Many women in need of such services did not access them, even if care was available locally. Additionally, there was a high rate of serious complications among women presenting to the hospital for cesarean delivery. Greater outreach and referral services as well as education among women and TM ~~traditional birth attendants~~ are needed to improve timely utilization of care. Our study also highlights the importance of performing local assessments of maternal health services in order to accurately measure community needs that otherwise may be underestimated by national surveys. These geographically focused evaluations are critical to inform policy and programmatic interventions at the community level.

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Unmarried	84 (27.4)
Lost a child during prior pregnancy, no. (%)	
Yes	113 (37.0)
No	192 (63.0)
~~**Last child delivered**~~**Site of delivery in immediate prior pregnancy,** no. (%)†	
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H~~At h~~ome with traditional midwife (TM)	210 (75.0)
H~~At h~~ome without TM	23 (8.2)
Why did you choose to deliver your child in this place?†	
Home, no. (%)	
'Cost' or 'Difficulty with transport'	69 (31.5)

'Quick onset of labor'	67 (30.6)
'Family tradition' or 'Religion'	37 (16.9)
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'Previous Cesarean delivery'	3 (6.7)

* Totals may not add to 307 due to missing values. 280 respondents reported age. 305 respondents reported parity.

† N=280 excluding nulliparous women

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Table 2. Comparison of characteristics of rural Liberian women who reported delivering their last child at home or in hospital, excluding nulliparous women (n=280)

Characteristic	HOME	HOSPITAL	P-value
Age, mean years (SD)	30.9 (7.3)	29.6 (8.3)	0.29
Parity, mean no. (SD)	4.9 (2.9)	4.5 (3.2)	0.32
Education level, no. (%)			
None	139 (59.9)	20 (43.5)	0.057
Some primary	84 (36.2)	22 (47.8)	
Completed primary or greater	9 (3.9)	4 (8.7)	
Relationship status, no. (%)			
Married	168 (72.1)	33 (70.2)	0.86
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Lost a child during prior pregnancy ~~or childbirth~~, no. (%)			
Yes	86 (36.9)	18 (38.3)	0.87
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