Review of Maternal Deaths in Lofa County, Liberia, 2015- 2017

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KEYWORDS: maternal mortality, Liberia, child birth

ABSTRACT

Introduction: Globally, 830 women die from pregnancy and childbirth daily. The maternal mortality ratio (MMR) in Liberia is 1072/100,000 live births. Maternal death is a priority event in Liberia, requiring immediate reporting. The causes and contributing factors of county-specific MMR are unknown. Therefore, data was analyzed to establish county MMR, and identify major causes and contributing factors of maternal death. **Methods:** A retrospective record review was conducted in Lofa County. Lofa has an estimated population of 358,612 inhabitants. We extracted data on age, marital status, educational status, place of death, cause of death, and contributing factors to maternal deaths from Maternal and Neonatal Death Surveillance Review Forms (MNDSR) for 2015-2017. Descriptive analysis was done using proportions and ratios. **Results:** Of the 46 maternal deaths reported, median age was 28 (range 12 - 50) years and age group 25-34 years accounted for 39% (18/46) of the deaths. Women at risk for maternal death were 7,427. The Lofa County MMR was 142/100,000 live births. About 86.9% (40/46) of deaths occurred in health facilities with and MMR was highest between April-June each year. Post-partum hemorrhage (PPH) accounted for 37% (17/46) of maternal deaths in Lofa County which is higher than the WHO target estimated at 15%. The decrease of MMR in Lofa County below the WHO estimate may be due to institutional factors and shortage of supplies towards the end of the fiscal year. **Conclusion:** The MMR of Lofa County is higher than expected with Post-Partum Hemorrhage being the leading cause of death due to poor management in health facilities We recommended provision of emergency stock to health facilities to be used at the end of fiscal period. We further recommend the inclusion of the type of cesarean section (CS) on the death review forms in order to determine the association between MMR and the type of CS.

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RECEIVED
09/12/2019

ACCEPTED
01/12/2020

PUBLISHED
05/2/2021

LINK

https://www.afenet-journal.net/content/series/4/1/6/full/

CITATION
Tamba Saah Alpha et al. Review of Maternal Deaths in Lofa County, Liberia, 2015- 2017. J Interval Epidemiol Public Health. 2021 Feb; Suppl 1: 6
DOI:
https://doi.org/10.37432/jieph.supp.2021.4.1.01.6

Introduction

Maternal mortality remains an event of major public health interest worldwide. Sustainable Development Goal 2030 aimed at improving Maternal Mortality Ratio (MMR) by <38% between the year 2000 and 2017 [1]. The WHO defines a maternal death as the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or made worse by the pregnancy or its management but not from accidental or incidental causes [2]. Maternal deaths can be caused by direct and indirect causes. The direct causes of maternal deaths result from the obstetric complications of pregnancy, interventions, exclusion, incorrect treatment, or a series of events resulting from any of the above[3]. The indirect causes of maternal death include the effects of pre-existing disorders, such as HIV infection, mental disease, and diabetes, when aggravated by pregnancy [3]. Globally, about 80% of maternal mortality cases occur due to post-partum hemorrhage, post-partum sepsis, obstructed labor and eclampsia [4, 5]. In 2016, the WHO recommended a minimum facility stay of 24 hours for women who had given birth to allow proper monitoring [6] since early discharge of women from the health facilities has been documented to contribute to infections among new mothers and babies in low-income countries [7].

In 2017 alone, approximately, 830 women were reported to have died from pregnancy and childbirth related causes on a daily basis [8]. However, the global maternal mortality burden decreased by 43.9% from 385 deaths per 100,000 live births in 1990 to 216 per 100,000 live birth in 2015 [9, 4]. More than 75% of global maternal deaths occur in Africa with an MMR of 436 per 100,000 live births [10]. Although countries in sub-Saharan Africa have decreased their maternal mortality ratios between 1990 and 2015, This still remains higher than the global target for 2030 (i.e.,<70 per 100000 live birth) [8, 9]. In Liberia, maternal death is one of the priority events that requires immediate reporting under the Integrated Disease Surveillance and Response (IDSR) [11, 12]. In Liberia, maternal death reviews were introduced in the year 2012. Statistics obtained from the death review forms at both health facility and community level indicated that the maternal mortality ratio in Liberia increased from 770/100,000 in 2010 to 1072/100,000 live births in 2015 [13] a ratio which is higher than that of most sub-Saharan African countries. The rapid increase in maternal death was associated with the introduction of the maternal death surveillance system and presence of the Ebola Virus Disease outbreak in the country during that period.

As a result of the increase in MMR in Liberia, and the need to improve reporting, the government of Liberia declared maternal mortality as a public health emergency to be reported within 24 hours and responded to in not more than 72 hours[14, 15]. Thus, surveillance and verbal autopsy of maternal death is conducted across the country to determine the causes of maternal deaths that occur at community and health facility level and ways of preventing their reoccurrence.

Despite the efforts to conduct surveillance and verbal autopsies of maternal deaths, women in Lofa county continue to die in communities and health facilities during childbirth or childbirth birth-related complications. In addition, county specific causes and contributing factors to maternal deaths are unknown. Therefore, we conducted this study to establish the Lofa county MMR, determine the distribution of maternal death by reporting sites, months, age, marital and educational status; measure maternal death by reporting months; calculate types of deliveries that resulted to maternal death; determine the proportion of live births and maternal deaths occurring at home and health facility; institutional factors contributing to maternal death, identify major causes and risk factors of maternal deaths in the county; assess death review forms for completeness; and make necessary recommendations for public health actions.

Methods

Study Setting: The study was conducted in Lofa County, Liberia. The county has 358,612 inhabitants with women of reproductive age accounting for (23%) 82,480 of the total population. The cumulative number of women that attended antenatal care from the year 2015 to 2017 was 7,539. The cumulative number of live births in the county between the same period was 31,989 with 5,499 community live birth deliveries. Fifty-seven out of 59 health facilities in the

county provide reproductive health services and are reporting sites for maternal events. There are 48 primary health care facilities or clinics providing reproductive health services including five health centers and four hospitals. Two of the hospitals, three clinics and one health centre are private faith-based facilities. Only the county´s referral hospital has an obstetric specialist with two obstetric technicians; the rest of the hospitals have two medical doctors each who are general medical practitioners. The county has four hospitals that provide laboratory and blood bank services where referrals are usually done. Each primary health facility and health center has at least two professional health care workers (i.e., a midwife, nurse or physician assistant) that are lodged by the community where the health facility is located in order to provide emergency health services at night and on public holidays. Health centers and hospitals provide 24-hour services including weekends and public holidays. Antenatal and post-partum services are provided at community and health facility levels.

At least one trained professional health worker is assigned as a surveillance focal person in each health facility to identify and report maternal death based on the standard case definition [15]. Maternal death surveillance is conducted at community and health facility levels using community surveillance structures (i.e. Community Health Volunteers, Community Health Assistants, Key Informants, Health Facility Surveillance Focal Persons and clinical screeners).

Study design: We conducted a Retrospective Chart Review (RCR) of maternal deaths reported from the facilities in Lofa County, one of the 15 counties of Liberia between 2015 and 2017. We retrieved data from Maternal and Neonatal Death Surveillance Review (MNDSR) forms obtained at both the health facility and community level. Verbal autopsies were conducted for all reported deaths at various levels of the county. Data from the surveillance database were compared with District Health Information System (DHIS) data at the county level to ensure accuracy of reported deaths and live births. All suspected maternal deaths were reported through the surveillance system, reviewed and classified as either maternal death or not. The verbal autopsies were conducted by death review teams at facility and community level and were verified by county level supervisors. The review teams include staff from various cadres of the health care system (Physicians, Physician Assistants, Midwives, Nurses, genitors, Traditional Birth Attendants, Trained Traditional Midwives, and Obstetrician Technicians) and community (i.e., Community Health Committees (CHC), Community Health Development Committees (CHDC) family members).

Variables: The variables extracted included age, marital status, education status, place of death, cause of death, and contributing factors to maternal deaths from Maternal and Neonatal Death Surveillance Review Forms for 2015-2017 (i.e., poor management, early discharge, blood transfusion and poor documentation of patient record).

Review forms were assessed for completeness. Cases were categorized into three {i.e., caesarean section (CS), normal vagina delivery (NVD) and never delivered (ND)} before death. We categorized age into <18, 18-24, 25-34, 35-44 and ≥ 45 years [16]. Marital status was categorized into three (i.e., single, married, and divorced). Education status was classified as formal education or skilled professional and no skilled or no formal education. Formal education was any case that had secondary education or skilled profession while no skilled professional or no formal education was any case that never had secondary education or skilled professional training.

Case definition: We defined maternal deaths according to Liberia´s IDSR technical guideline: *"the death of a woman while pregnant or within 42 days of the delivery or termination of the pregnancy, regardless of the duration and site of the pregnancy, from any cause related to the pregnancy or its management but not from accidental or incidental causes´* [17]. "Poor management" was defined as the inability of health worker to identify risk factors during antenatal care (ANC), inappropriate recording of patients´ data, inappropriate or no monitoring of patients with partograph during delivery, missed diagnosis and treatment of patients. "Early discharge" any complicated delivery discharged within 48 hours of delivery and normal deliveries discharged within 24 hours of delivery. This definition is similar to WHO definition for early discharge after child delivery: "**Early** postnatal hospital **discharge** generally refers to the **postpartum** hospital **discharge** of the mother and newborn within 48 hours". The duration of **what is** considered "**early discharge**" varies

between countries from 12 to 72 hours due to the differences in average duration of hospital stay" [7]. Normal Vaginal Delivery (NVD) is defined as spontaneous in onset, low-risk at the start of labor and remaining so throughout labor and delivery. The infant is born spontaneously in the vertex position between 37 and 42 completed weeks of pregnancy. After birth, mother and infant are in good condition" [18]. Complicated Delivery (CD) is any Labor occurring with an accompanying abnormal condition (s) such as hemorrhage or inertia and requiring medical intervention like Caesarean Section (CS) [19]. Assisted vaginal delivery is any vaginal delivery of a baby carry out with the help of forceps, other instruments or a vacuum devices and it is sometimes referred to as operative vaginal delivery [20]. Thus, this ty of delivery was considered as complicated delivery.

Data management: Data were cleaned and univariate analysis conducted to obtain frequencies and proportions of age, sex, marital and educational status. The Maternal Mortality Ratio (MMR) was calculated using the number of deaths per month as numerator and live births per month as a denominator. The numerator included all deaths that met the case definition of maternal death reported at various levels (i.e., community and health facility) and the denominator included live births at health facility and community that were attended to by either skilled or unskilled birth attendants. We used the cumulative maternal death as the numerator and cumulative live birth for the study period as the denominator. We analyzed MMR by month of reporting to note the trend at which the deaths were occurring. We used Microsoft excel 2013 and Epi. Info7.5 to conduct descriptive analysis.

Availability of data and matter: Death review data was readily available at the county in both hard and soft copies.

Ethical considerations: We obtained written approval to use the data for our study from Lofa County Health Team (LCHT) and the Ministry of Health, Liberia. We delinked data from personal identifiers and assured proper handling and storage of the information for the purpose of confidentiality throughout our study.

Results

Seven out of 57 health facilities reported maternal deaths for the period of 2015-2017. A total of 61 suspected maternal deaths were reported out of which 46 met the inclusion criteria through verbal autopsy for the three years (i.e., 2015 - 2017). We found that 74% (34/46) forms were properly filled with no missing variables. Approximately 83% (38/46) deaths were reviewed within 72 hours. The proportion of live birth at health facility level was 82.8% (26490/31989).

Maternal mortality ratios: The overall MMR of Lofa County for the three-year period was 142/100,000 live births. The highest monthly MMR (615/100000 live births) was recorded in the month of May, 2016. Annual trends showed that maternal deaths peaked from April to June (154-381/100,000 live births). The highest community MMR was 194/100,000 live births in 2016. The highest health facility MMR recorded was 584/100,000 live births Figure 1. Women at risk that had live births during this study period were 7,427. Median age was 28 (12 - 50) years. We found out that women who were in the age category 25 - 34 years accounted for 39% (18/46) of the maternal deaths Table 1; and 41% (19/46) of the deaths occurred among married women Table 1. No formal education accounted for 74% (34/46) of maternal deaths Table 1. Majority of the maternal deaths 83% (38/46) occurred in health facilities and 17% of maternal deaths occurred in the community. About 83.3% (43/52) of the staff that attended to confirmed maternal deaths were trained in emergency obstetrics care (EmOC). About 48% (22/46) of deaths had complicated delivery, 36% (17/46) women had normal vaginal delivery yet they died and 15% (7/46) deaths died with pregnancy.

Causes of death and the contributing factors

37 causes of death reported were due to direct causes, while 9 causes were due to the indirect causes. Postpartum hemorrhage (PPH) accounted for 37% (17/46) of the deaths while 22% (10/46) were due to sepsis Table 1. The major contributing factors of maternal death were poor management 61% (28/46) and early discharge 17% (8/46). Missed diagnosis of medical condition during ANC visits and labor accounted for 17% (8/46), not identifying risk factors during ANC 15% (7/46), lack of monitoring during emergency care 11% (5/46), and transfusion

reaction accounted for 10% (5/46) of maternal deaths in the county Table 1. About 80% (8/10) of mothers that died as a result of sepsis were among those who were discharged within 48 hours from health facility after complicated deliveries. Among death with PPH as a contributing factor, 29% (5/17) had transfusion reaction in health facilities. About 78% (36/46) maternal deaths (78%) occurred during the postpartum period; while 43% (20/46) occurred after caesarean section procedure Figure 2. Thirty-nine of the deaths (85%) were attended to by professional heath care workers during delivery.

Discussion

We found that post-partum hemorrhage and sepsis were the highest primary causes of maternal death. Missed diagnosis, inappropriate recording of patient information and lack of proper management of active phase of labor among others were contributory factors for maternal death. Early discharge from the health facility for both normal and complicated deliveries contributed to higher proportion of maternal deaths. Result of this study showed increased proportion of maternal deaths among married women. Maternal death was higher among women with no formal education, which could probably be due to limited knowledge about antenatal care. The result showed that a higher proportion of maternal deaths were reported in health facilities compared to the communities. More maternal deaths were recorded between the months of April to June. The age category 25-34 years showed a higher proportion of maternal mortality. Most of the death review forms were completely filled by the review teams.

MMR in Lofa County was lower than the national MMR, although doubled the Sustainable Development Goal [15]. This may be due to referral of majority of deliveries from community to health facility as required by MNDSR system [16]. The high number of maternal deaths that occurred during the postpartum period could be due to inadequate emergency obstetric care (EmOC) skills application. Similar to findings in Ghana on hospital based maternal care, we found out that poor management in the health facility by skilled health care workers contributed to increased maternal mortality [21]. The high proportion of MMR due to early discharge from health facilities as well as the high proportion of PPH and sepsis could be indicative of the gaps in EmOC services and poor IPC compliance at health facility and community level. Another review conducted in Ghana on "Community-based surveillance of maternal deaths in rural Ghana´ indicated higher maternal deaths recorded in health facilities than communities which is similar to our finding [8]. In addition, early discharge for mostly complicated deliveries increases chances of acquiring sepsis and other infections in the health facility. This finding is similar to that of a study that was conducted in Ghana on review of maternal death in which mothers spent at most eight hours after delivery [19]. Additionally, the increased number of maternal deaths among married women could be attributed to the fact that married women often need financial support from their partners before seeking care. Women with no formal education experienced more maternal deaths compared to those who had formal education. This may be due to the fact that women with no formal education lacked information about the importance of health facility delivery. The decrease in MMR in the County is an indication of community awareness for discouraging home deliveries. However, the increase in MMR at health facility level is an indication of adherence to the referral system from communities to health facilities although fewer women are still having home deliveries.

Strength and Limitation

The review teams at various levels were responsible for confirming death as either maternal or non-maternal death through death review. However, the limitation was that not all deaths were diagnosed by health workers who had the same training and expertise. Conducting a review of all the deaths by the County Death Review Team including the County Health Officer who is always a Medical Doctor minimized this limitation. All death review forms were signed by the death review team members to ensure authenticity. Data from both sources was limited to the three years due to the newness of the surveillance system on maternal death. In addition, data on the type of cesarean Section (CS) was not available (i.e., elective and non-elective CS). Variables that were analyzed in this study were the only ones seen on the verbal autopsy forms.

Conclusion

Though the MMR of Lofa County is higher than the minimum MMR required by sustainable development goal for 2030, it is lower compared to results in previous studies. Although more women are referred for safe delivery from the community to the health facility, they still faced institutional risks or challenges may cause maternal death. Most of the mothers died during this study period as a result of PPH and sepsis. Maternal mortality is common amongst women with no formal education. In Lofa, more maternal deaths are reported towards the end of fiscal year. We recommend a further study to determine the institutional factors contributing to poor management of deliveries at the health facility. Lofa County Health Team should increase mentorship and behavior change practices among health care workers on EmOC to reduce maternal death in the facilities. We also recommend that the National Public Health Institute of Liberia (NPHIL) should include more variables (socioeconomic) on verbal autopsy forms. We further recommend the inclusion of the different types of CS on the death review forms in order to determine the association of MMR to the type of CS.

What is known about this topic

- In Liberia and Africa as whole, it is documented that the major contributing factors to maternal mortality are the "three delays" (i.,e delay in deciding to seek appropriate medical help for an obstetric emergency; delay in reaching an appropriate obstetric facility; and delay in receiving adequate care when a facility is reached) [22].
- It is also known that globally, the leading causes of maternal death are hemorrhage and sepsis which is also in line with findings from our study.
- Additionally, it is known in Liberia that more maternal deaths occur in community compared to the health care facility [23].

What this study adds

- We found that early discharge of complicated deliveries from health facility may have impacted MMR in Lofa County.
- The study also noted that poor management in health facility can directly impact MMR. Missed diagnosis and not identifying risk factors during ANC may cause poor management and increase MMR.
- Additionally, we found that more maternal deaths were reported in the months of April to June for all the three years with the highest number of cases recorded in 2016.This may be due to the shortage of essential drug in health facilities as a result of end of the physical year that runs from July to June.

Competing interests

The authors declare no competing interests.

Funding

This research work was funded by Africa Field Epidemiology Network (AFENET) through the National Public Health Institute of Liberia.

Authors' contributions

TSA developed the research proposal, collected the data and conducted the analysis including manuscript write-up. The co-authors assisted in data verification, review of research tools and analysis: DD. and EA. participated in data collection, review and maternal and reproductive health technical guide. NJB. Provided research guidelines for data collection and also help to review the draft work. LBK. Supported the research by prove reading. JAF. Assisted in the development of data collection tool and guidelines in the usage of Epi. Info 7.2. MA, PA. and OI provided technical guidelines on collection tools and review of the paper. FS and HW reviewed draft research tool and manuscript, RKVM and JRM. Provided technical support in understanding the variables on the review forms.

Acknowledgements

Special thanks to the Lofa County Health Team, National Public Health Institute of Liberia, and Africa Field Epidemiology Network for the financial and moral support provided in getting this work done. It would have been impossible for this work to

be present had it not been the Lofa County health team and World Health Organization coordinator assigned in Lofa to provide technical support. It was a great honor to have worked with mentors of Liberia FETP in providing necessary guidance in this research.

Tables and figures

Table 1: Educational Status and Marital Status of Maternal Deaths, Lofa County, 2015-2017
Figure 1: Trend of MMR by months, Lofa County, Liberia, 2015-2017
Figure 2: Type of Delivery of Maternal Deaths, Lofa County, 2015-2017

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Table 1: Educational Status and Marital Status of Maternal Deaths, Lofa County, 2015-2017

Educational Status	**Number (N=46)**	**Proportion (%)**
No Formal Education/<7 Grades	34	74
Formal Education/>=7 grades/Secondary Education	12	26
Marital Status	**Number (N=46)**	**Proportion (%)**
Single	18	39
Married	19	41
Divorced	9	20

Age Category of Maternal Deaths, Lofa County, 2015-2017 N=46

<18 Years	18-24 Years	25-34 Years	35-44 Years	≥ Years
5%	33%	40%	20%	2%

Major Causes of Maternal Death, Lofa County, 2015-2017 N=46

PPH	Sepsis	Ruptured Uterus	Eclampsia	Abortion	Anemia	Abruptio Placenta	Ruptured Ectopic	Retained Placenta
37%	22%	13%	8%	8%	6%	2%	2%	2%

Major Contributing Factors of Maternal Death, Lofa County, 2015-2017 N=46

Poor Management	Early Discharge	Transfusion Reaction	Delay Referral	Herbal Injection	Cephalopelvic Disproportion
61%	18%	10%	5%	3%	3%

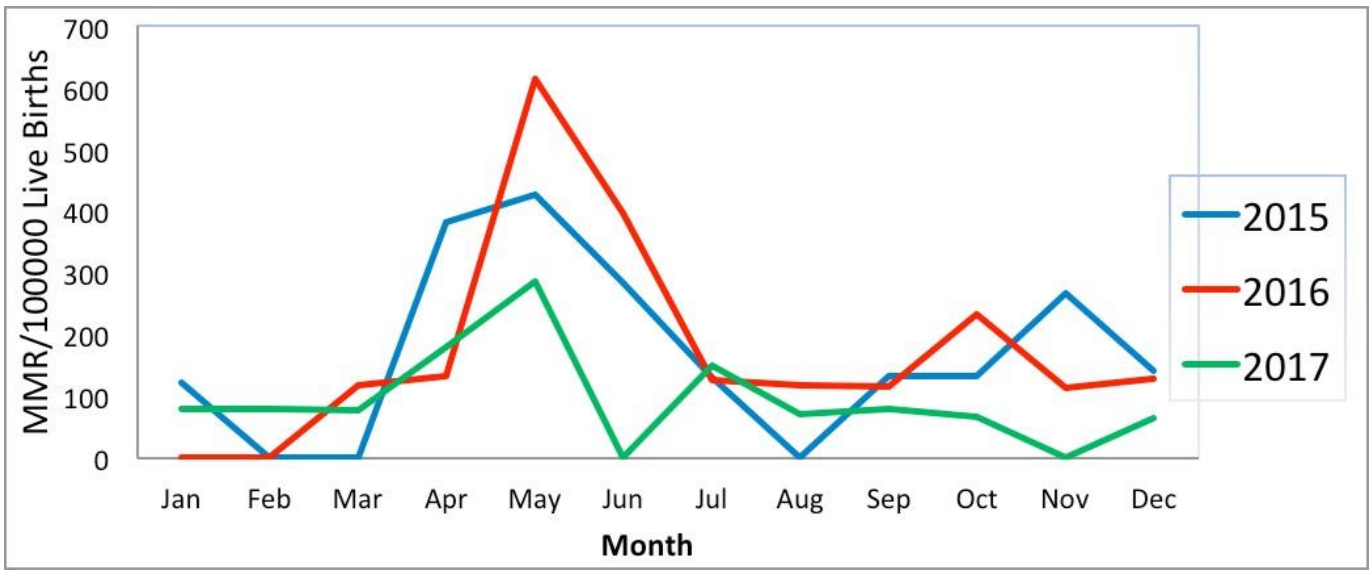

Figure 1: Trend of MMR by months, Lofa County, Liberia, 2015-2017

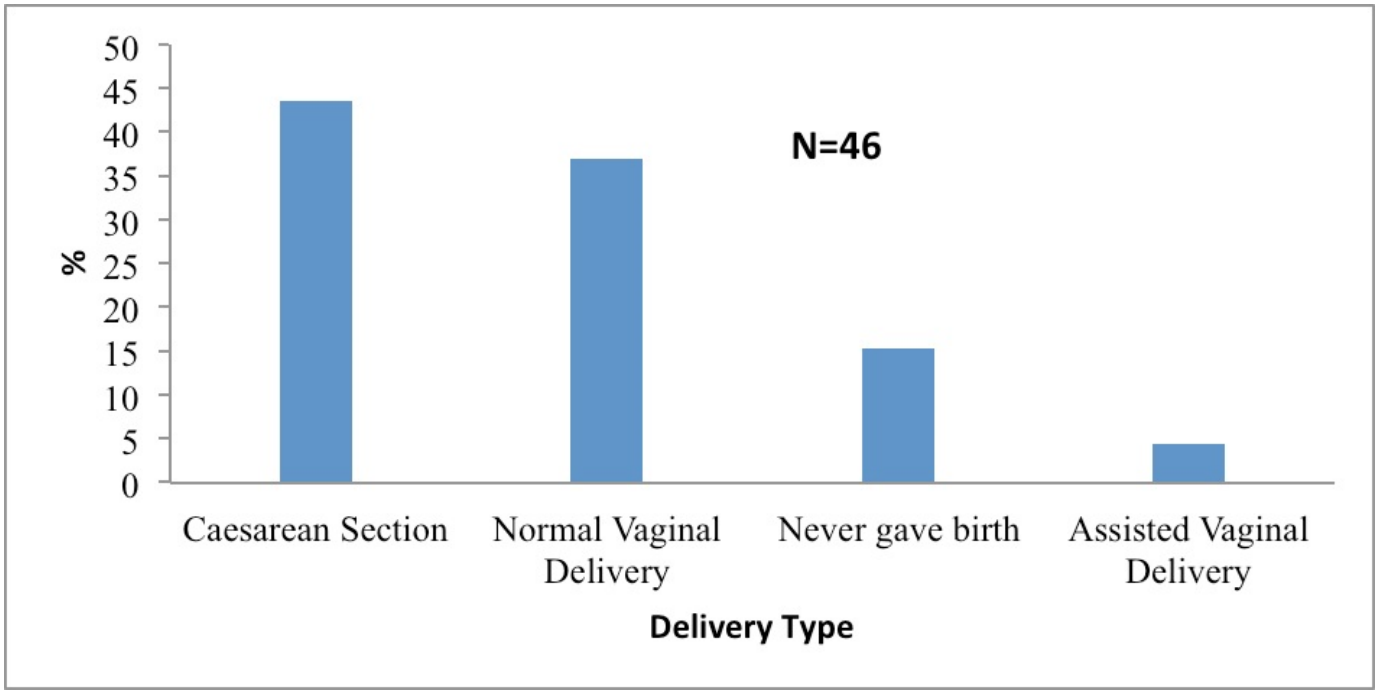

Figure 2: Type of Delivery of Maternal Deaths, Lofa County, 2015-2017