

Original Research Article**Determinants of Maternal Mortality in Mezam Division in the North West Region of Cameroon: A Community-Based Case Control Study****Abstract****Background**

Since 2008, an average of 358,000 women die annually worldwide of pregnancy-related causes. About 99% of these deaths occur in developing countries, 43% of which occur in Sub-Saharan Africa alone. In Cameroon, the rate has increased from 669 maternal deaths/100,000 live births in 2005 to 1000/100,000 live births in 2010. Socio-economic, cultural, and obstetric factors have been found to account for this jump.

Objectives

The aims of this study were 1) to identify the causes, both direct and indirect, of maternal mortality, 2) to investigate the factors associated with maternal deaths, and 3) to describe the age distribution of maternal mortality in Mezam Division in the North West Region of Cameroon.

Materials and Methods

We carried out a retrospective, community-based case-control study from January 1, 2011 to November 30, 2014 on 89 maternal deaths (cases), and 178 women who survived delivery (controls). Cases were identified with the aid of key community leaders. A questionnaire for maternal death review or verbal autopsy was administered and controls effected among the sisters or neighbours of the cases. Microsoft Excel, Epi Info and InterVA-4 were used for data analysis.

Results:

A total of 89 maternal deaths (cases) were identified during the study period, sixty-nine (77.53%) of which were from direct causes, mainly post-partum haemorrhage

(30.43%), unsafe abortion (26.09%), and hypertensive disorders of pregnancy (14.49%); 21.35% from indirect causes, while 1.12% were incidental deaths, mainly severe malaria (5.6%), HIV/AIDS (5.6%). Among the risk factors of maternal death were inadequate antenatal care(RR=1.87: 95% CI; 1.33-2.63, P=0.0003), pre-existing co-morbidities(RR=1.45: 95% CI; 1.03-2.03, P =0.03), place of delivery(RR= 2.44: 95% CI; 1.79-3.32,P<0.0001), healthcare provider qualification(RR= 2.87: 95% CI 2.17-3.79; P<0.0001), and delays in arrival at health facilities(RR=1.420: 95% CI 1.01-2.0; P=0.04). The peak age of maternal death ranged from 20-24 years (24.72%).

34 Conclusion

35 Post-partum haemorrhage, unsafe abortion and hypertensive disorders of pregnancy
36 were the leading causes of maternal death. Effectively combating the factors associated
37 with maternal deaths will reduce if not eliminate maternal morbidity.

38 **Key Words:** Maternal mortality, Risk Factors, Direct and Indirect Causes, Co-morbidities

39 Background

40 The number of women dying from pregnancy and pregnancy-related complications has
41 fallen by nearly half in the past 20 years, according to 2012 estimations published by the
42 United Nations Children's Emergency Fund (UNICEF), World Health Organization
43 (WHO), Population Fund (UNFPA) and the World Bank (Cameroon Agenda for
44 Sustainable Development's Journal)[1–3].

45 Although efforts have been made by international bodies to limit maternal mortality, it
46 still constitutes a major public health problem in Cameroon and other sub-Saharan
47 African countries[3]. Worldwide, maternal mortality is the main form of death amongst
48 females aged 15 – 49 years[2]. Over 1500 women die daily (one death per second) from

49 pregnancy-related causes. This approximates to 550.000 maternal deaths yearly
 50 (Human Rights Council)[4, 5]. Estimates produced by the WHO, UNICEF, UNFPA, and the
 51 World Bank suggest that globally, about 260 women die per 100.000 live births. 99% of
 52 these deaths are in sub-Saharan Africa (WHO)[6, 7].

53 From 2010 estimates, Africa recorded the highest maternal mortality ratio (MMR) of
 54 620 per 100.000 live births while Europe recorded the least worldwide: 21 maternal
 55 deaths per 100.000 live births. Greece recorded the lowest pregnancy-related maternal
 56 deaths: 2 per 100.000 live births, and Afghanistan the most alarming pregnancy-related
 57 maternal deaths: 1400 per 100.000 live births (WHO)[7].

58 In sub-Saharan Africa, the lowest MMR was recorded in Cape Verde, 94 per 100.000 live
 59 births, whereas Chad and Somalia documented 1200 per 100 000 live-births, the highest
 60 MMR (WHO). All these statistics show considerable disparities in maternal wellbeing
 61 across the globe, with sub-Saharan Africa suffering the poorest conditions[7].

62 Substantial progress has been achieved in almost all countries; but by every indication,
 63 Cameroon and many countries in sub-Saharan Africa have failed to reach the Millennium
 64 Development Goal (MDG) target of reducing maternal death by 75 per cent from 1990 to
 65 2015. Cameroon's MMR is akin to those of other countries in sub-Saharan Africa, with a
 66 MMR of between 584 and 890 per 100.000 live births in 1995[8]. The overall maternal
 67 mortality ratio for Maroua was 1266 per 100 000 live births in a hospital-based study. In
 68 2010 and in the same town the rate was 1000 per 100.000 live births on a population-
 69 based setting[9].

70 According to the Maternal, New-born and Child Survival Count Down to 2015, Cameroon
71 in the preceding 20 years has managed to reduce the number of maternal deaths per
72 every 100 000 deliveries from 680 to 600, a drop of 11 per cent[10][11, 12].

73 **1.2. Problem statement**

74 The known risks of maternal mortality and the available international data
75 notwithstanding, still very little is known about the exact situation of the phenomenon
76 in Mezam Division of the North West Region of Cameroon. One cannot state with
77 certainty the causes or the factors that account for maternal pregnancy-related deaths in
78 that area, nor identify the most affected age group of women since the factors most
79 responsible for maternal death in the various age groups in the area have not been
80 documented. The causes, be they direct or indirect, of maternal mortality in that
81 Division are yet to be identified.

82 It is not known what preventive measures can be put in place to reduce pregnancy-
83 related deaths in this study area.

84 **1.3. Justification**

85 Maternal health continues to be the object of increasing global concern, particularly in
86 sub-Saharan Africa. In the year 2000, the 181 UN member countries revealed the
87 Millennium Declaration Initiative[13] summarized under eight major points known as
88 the Millennium Development Goals (MDGs), to be realised by the year 2015. MDG5 on
89 maternal health had as objective the reduction of pregnancy-related maternal deaths by
90 75% between the years 1990 and 2015[12].

91 A study carried out in twelve maternities in Benin, Ivory Coast and Senegal, revealed
92 that hypertensive disorders and post-partum haemorrhage caused 29% and 15% of
93 maternal mortalities in the three African countries respectively[14]. Inconsistency in

clinical diagnosis of the causes of maternal deaths has also been reported as a possible reason why the deaths remain persistent[15]. Age, parity, obstetric factors, education of mothers, unavailability or inaccessibility of health services and skilled health personnel, and socio-economic factors, have been reported to be responsible for the increase in the number of maternal deaths. Infectious diseases related to maternal mortality are often under diagnosed whilst hypertensive disorders of pregnancy including eclampsia are in most cases over-diagnosed[9].

It is therefore of paramount importance to know the causes and factors associated with maternal deaths in Mezam Division in order to device strategies to reduce maternal mortality in this area.

1.4. Research goal

The aims of this study were 1) to identify the causes, both direct and indirect, of maternal mortality, 2) to investigate the factors associated with maternal deaths, and 3) to determine the age distribution of maternal mortality in Mezam Division of the North West Region of Cameroon.

2. Materials and Methods

2.1. Study design

We carried out a retrospective, community-based 1:2 matched case-control study of maternal deaths during the period January 1, 2011 to November 30, 2014 in Mezam Division. All the pregnancy-related maternal deaths (cases) and controls were enrolled randomly from sisters or neighbours of the deceased who survived childbirth during the study period December 15, 2014 and March 31, 2015. Two controls were matched with one index case. For all the cases, the cause and factors associated with maternal death

were determined using a WHO standardized questionnaire for maternal death review (verbal autopsy).

The Divisions of the North-West Region are shown in **figure 1**.

Table 1: Mezam Division has five health districts, comprising fifty-eight health areas, and a total population of about 575,312 inhabitants made of people of diverse cultural and religious backgrounds, educational levels and social status.

Inclusion Criteria:

All Women who died from pregnancy-related causes and those who had safe deliveries in this community during the study period were included in the study.

Exclusion Criteria:

All maternal deaths from confirmed non-pregnancy-related causes or pre-pubertal and menopausal subjects were excluded from the study as were maternal deaths out of this study period.

2.2. Sampling

All pregnancy-related deaths for study (cases) were recruited from the five health districts and the 58 health areas in the Division, with the assistance of community leaders: quarter heads, sub chiefs and chiefs, church leaders, who are usually informed of deaths in the community. This strategy facilitated the identification of cases. Once the cases were identified by the community leaders, we then traced and administered a questionnaire to a close relation of the index case and who was present before, during and after her death.

Two women per index case who survived vaginal birth (controls) were selection by random sampling amongst the sisters or neighbours of the deceased.. Equally, one mother was randomly recruited per polygamous household.

2.3. Sample Size Calculation

Working from a hypothetical odds ratio of $2(\theta)$, where θ is a hypothetical odds ratio for a woman to die from an identified pregnancy-related risky behaviour, compared to those without risky behaviour, and the probability of a pregnant woman to die from an identified cause to be 60% (π_o). (This is not a sentence.) The degree of significance, α , set at 0.05 (two-tailed) giving; and the power of the study set at 90% giving $Z_{1-\beta} = 1.28$.

We calculated the probability of the control group to die from the same cause as has been described previously[16], and obtained a minimum sample size of 284 participants. Taking two controls for one case, we had a minimum sample size of 94 cases to 184 controls (1:2 matching).

2.4. Study procedure

After obtaining administrative approval and ethical clearance, we recorded all pregnancy-related deaths in the community as cases. This was achieved by visiting all the five health districts and 58 health areas in Mezam Division, mainly with the assistance of community leaders: headquarters, sub chiefs and chiefs, church leaders, who are usually informed about deaths in the community. This procedure facilitated the identification of cases. Once the cases were identified by the community leaders, we then served a face-to-face interviewer-administered questionnaire to a close relation of the deceased.

The controls were obtained by random sampling technique of the sisters or neighbours of the deceased who had successful deliveries about the same time when the deceased succumbed to childbirth. For each of the index cases, we recruited two mothers as controls. We randomly selected one mother per household in households containing more than one mother.

For all the cases, the cause of death was determined using a WHO standardized questionnaire for maternal death review (verbal autopsy)[15, 17]. Data on socio-demographic characteristics (religion, marital status, ethnicity, and occupation) and disease patterns of the participants in this study were obtained and recorded on the questionnaires. Information on variables such as age at the time of death or delivery, marital status, number of previous pregnancies (gravidity), number of previous births (parity) and number of antenatal care visits was also collected and entered into Microsoft Excel 2010 spread sheet. For this study, maternal death was defined as the death of any woman from any cause while she was pregnant and up to forty-two days after termination of pregnancy, regardless of the length and site of pregnancy (i.e. intra-uterine or ectopic). Deaths were classified as resulting from direct, indirect or unknown causes. A direct maternal death was death that resulted during the management of a pregnancy condition, labour, delivery or postpartum. An indirect maternal death was defined as a case in which pregnancy exacerbated a pre-existing health condition. The responses from the verbal autopsy were used to arrive at the probable causes of maternal death. This was achieved by inputting the responses into InterVA-4 software that had been designed to be compatible with the WHO 2012 Verbal Autopsy questionnaire. InterVA-4model was used for the interpretation of verbal autopsy (VA) data in order to arrive at probable causes of death and to be used in all communities irrespective of age.

2.5. Data Management and Analyses

The questionnaires were cross-checked for completeness and coded to ensure participant's confidentiality. We entered the collected data into a log-book and then after into Epi-Info™ version 7.1.4.0 (CDC, Atlanta, USA) statistical software for analysis and also exported to Microsoft™ Excel 2007 and interVA-4.

To study the predictor variables for identifying the cause of maternal death (time of death, gestational age, place of death, presence of co-morbidities, qualification of healthcare provider) we used the responses for the verbal autopsy questionnaire and frequency tables were created. To investigate the factors associated with maternal death (occupation, level of education, extremes of age, marital status, number of previous deliveries, number of antenatal care visits, minimum time to arrive health facility, qualification of healthcare provider and presence of comorbidity) a bivariable analysis was done and comparison between two groups was with the Chi Squared and Fisher's exact tests where appropriate. To determine the maternal age at the time of death, we grouped maternal age into a range of 5-years each. The age group with the highest frequency was considered the most affected. The outcome variables were maternal death for the cases and maternal survival from delivery for the control group. A two tailed P value<0.05 were considered to be statistically significant.

2.6 Ethical consideration

- Administrative authorization was obtained from the Regional Delegation of Public Health for the North West Region, Cameroon; and
- Ethical clearance was obtained from the Institutional Review Board (IFB) of the Faculty of Health Science, University of Buea, Cameroon.

- A signed informed consent form was obtained from each study participant after the purpose of the study had been explained to them. The questionnaires were anonymous and answers were kept confidential.

3. Results

We visited 45 out of 58 (77.6%) of the health areas in Mezam Division, and identified 89 cases of pregnancy-related maternal deaths during the four years under study. We also recruited 178 participants who gave birth normally to serve as controls, giving a total number of 267 participants.

Table 2: The distribution of maternal mortality in the five health districts of Mezam Division during the four years of study.

Figure 2: The trend in absolute numbers of maternal deaths in this study showed a sharp decrease from 2011 to 2012, then a gradual increase in the following years.

3.1 Socio-demographic characteristics

Table 3:

The global average age was 27.51 (SD 7.28) years; range from 15 to 43 years. The mean age between the cases and controls was comparable 28.53 (SD 7.9) years versus 27.01 (SD 6.9) years, $P=0.106$. All the factors studied (age, marital status, occupation, level of education, religion, settlement and best means of transport) were not statistically significant.

3.2 Behavioural and Obstetrical Characteristics

Table 4:

Forty-two (15.7%) never attended antenatal care, while 86 (32.2%) attended 1 to 2 times, and 139(52.1%) more than two times amongst the two groups ($P=0.002$). One hundred and eighty-seven (70.4%) participants did not have any pre-existing comorbidity whereas 80(29.6%) had one or more comorbid condition (malaria, hypertensive disorder, heart disease, respiratory disease, HIV/AIDS, Diabetes mellitus, anemia and others) ($P=0.038$). Two hundred and thirty-seven (88.8%) participants gave birth in a hospital, while 30(11.2%) delivered in other places (home, traditional facilities, on the way to the hospital) ($P=<0.0001$). Two hundred and thirty-five (89.0%) participants received care from healthcare providers, while 32(11.0%) did not ($P<0.0001$). Among the two groups, one hundred and sixty-one participants (60.3%) can use less than one hour to reach a health facility, and 106(39.7%) at least one hour ($P=0.042$).

3.3 Causes of maternal mortality

As shown in **Figure 3**, sixty-nine (77.53%) deaths were from direct causes, 19(21.35%) from indirect causes and one (1.12%) was from an incidental cause,.

Amongst the direct causes, post-partum haemorrhage accounted for 30.43%, while unsafe abortion accounted for 26.09% and hypertensive disorders of pregnancy was responsible for 14.49% of maternal deaths (**Figure 4**).

Regarding the indirect causes of maternal death, severe malaria (26.31%) and HIV/AIDS (26.31%) were the leading causes while anemia, lung disease and others accounted for 15.79% each (Figure 5).The only incidental cause accounting for 1.12% was a road traffic accident.

3.4 Timing of maternal mortality

Twenty-four (26.96%) of the deaths occurred during pregnancy (pre-partum), 49 (55.05%) deaths occurred during labor or intra-partum, 16(17.98%) deaths occurred after delivery or in the immediate post-partum period.

3.5. Age distribution of maternal mortality

The ages were grouped into five yearly intervals. The age group 20-24 years had 22 maternal deaths followed closely by the 35-39 years group with 19 maternal deaths

Table 5.

3.6. Factors associated with maternal mortality

Table 6:

The relative risk of inadequate use of antenatal care was 1.87 times higher among women who died, compared with women who survived (RR=1.87: 95% CI 1.33-2.63; P =0.0003).

Women who died were also found to have a 1.45 higher relative risk of medical co-morbidity (RR=1.45: 95% CI 1.03-2.03; P=0.032). Women who died from pregnancy-related causes had a 2.44 higher relative risk of delivering out of a hospital setting compared with those who delivered in a hospital (RR= 2.44: 95% CI 1.79-3.32; P =<0.0001).

Participants who died from pregnancy-related causes were also found to have 2.44 higher relative risk of giving birth at home or out of a health facility than controls (RR=2.44:95% CI 1.79-3.32; P<0.0001).

Women who died were also found to have 2.87 higher relative risk of having given birth with the assistance of a non-medical healthcare provider (traditional birth attendant etc.) compared to controls (RR= 2.87: 95% CI 2.17-3.79; P =<0.0001).

Finally, participants who died also had a 1.42 higher relative risk of having to use more than one hour to get to a health facility compared to controls (RR=1.42: 95% CI 1.01-1.99; P =0.041).

4. Discussion

Main findings

Our study was aimed at identifying the cause of maternal mortality and factors associated with maternal pregnancy-related deaths. This study was also aimed at determining the age distribution of maternal mortality.

The global average age was 27.51 (SD 7.28) years; range from 15 to 43 years. The mean age between the cases and controls was comparable 28.53 (SD 7.9) years versus 27.01 (SD 6.9) years

Most of the maternal deaths resulted from direct causes (77.53%)(Postpartum hemorrhage (30.4%), unsafe abortions (26.1%) and hypertensive disorders of pregnancy (14.5%). Majority of the deaths occurred during labour or the intra-partum period and women who died were usually in the age bracket 20-24 years.

We found five factors to be associated with maternal death from direct pregnancy complications: inadequate use of antenatal care, pre-existing medical co-morbidities, place of delivery, untrained healthcare providers, and time to reach health facility greater than one hour.

Interpretation in light of other evidence

Sixty-nine (77.53%) of maternal deaths were from direct causes, 19(21.35%) from indirect causes, and one (1.12%) was an incidental death. This was similar to WHO data on causes of maternal mortality[18][19]. Our results were different from those obtained by Kongyuy et al. [20] in a facility-based study in Malawi, where they had 65.1% direct obstetric deaths and 34.9% indirect obstetric deaths. This difference could be due to the difference in study design and setting.

Twenty-four (26.96%) of the deaths occurred during the pre-partum period, 49 (55.05%) during child birth (intrapartum), and 16(17.98%), occurred after delivery (post-partum). Ghebrehiwet et al. [21] in Eritrea reported 16%, 48% and 36% respectively. This difference could be due in part to the high prevalence in our study of death due to unsafe abortion; but also to the geographical location, study setting, and difference in study design.

The leading direct causes of maternal mortality identified in our study were post-partum haemorrhage (30.43%), unsafe abortion (26.09%) and hypertensive disorders in pregnancy (14.49%). Similar results were obtained in the South West Region of Cameroon by Hale et al.[22]; in Koforidua, Ghana, by Gabriel et al.[23]; and Accra, Ghana, by Zachariah et al. [24]. Tebeu et al. [25]in Maroua and Fomulu et al. [26] at the University Teaching Hospital, Yaoundé, showed that hypertensive disorders in pregnancy accounted for most of the maternal deaths. This difference could be due to the fact that our study was not a hospital-based study, and to the increasing knowledge in management of hypertensive disorders in pregnancy. However, worldwide, the leading causes of maternal death are still hemorrhage, hypertension, sepsis, obstructed

labour, and unsafe abortions. Indirect causes, for their part, are gaining in importance in developed countries [27].

The leading indirect causes of maternal mortality found in our study were severe malaria (26.31%) and HIV/AIDS (26.31%), followed by anaemia and lung disease, 15.79% each. Similar results were obtained by Ghebrehiwet et al. [21] who reported that severe malaria and HIV complications were the leading indirect causes of maternal mortality. Similar findings were reported by Ekane et al. [22], Tebeu et al. [25], and Agan et al. [28], Kongnyuy EJ et al. [20], Combs Thorsen V aet al. [29], Vink NM et al. [30] and Tim Colbourn et al. [31]. In African countries like South Africa and Zimbabwe, the increase in HIV prevalence has reversed the reduction in maternal mortality. The risk of a woman dying as a result of pregnancy or childbirth during her lifetime is about one in six in the poorest parts of the world compared with about one in 30 000 in Northern Europe. Such a discrepancy poses a huge challenge to meeting the fifth Millennium Development Goal of reducing maternal mortality by 75% between 1990 and 2015. Some developed and transitional countries have managed to reduce their maternal mortality during the past 25 years. In most of them, especially the poorest, however, their very high maternal mortality rates, weak health systems, continuing high fertility, and poor availability of data jeopardise progress rather seriously.

Maternal deaths are clustered around labour, delivery, and the immediate postpartum period, with obstetric haemorrhage being the main medical cause of death. Local variation can be important, with unsafe abortion constituting huge risks in some populations, and HIV/AIDS becoming a leading cause of death, especially in countries where HIV-related mortality rates are high. Inequalities in the risk of maternal death

exist everywhere. Targeting the most vulnerable rural populations and poor people for intervention is essential if substantial progress is to be achieved by 2015[32].

ANC attendance: women who never attended ANC were more likely to die from pregnancy-related complications than those who attended at least once. (RR=1.87: 95% CI 1.33-2.63; P =0.0003). These findings are similar to those of Ekane et al. [22], and Ujah et al. [33]. However, Agan et al. [28]reported that about 69.26% of women in their study had no antenatal care whereas in our study, 66 (74.2%) had antenatal care. This picture may reflect the poor quality of ANC in our settings. On the other hand, Mbuagbaw et al. reported that almost 66% of women out of 7,557 women taken from the 2004 Demographic and Health Survey data in Cameroon had optimal antenatal care and were more likely to deliver in a health unit (OR 2.91; 95% CI 2.42–3.49), to be assisted by a skilled health worker during delivery (OR 1.88; 95% CI 1.49–2.37) and to have a baby with a normal birthweight (OR 1.62; 95% CI 1.11–2.38) [34]

Presence of comorbidity: Women who had comorbidity were more likely to die from pregnancy-related complications when compared with those without (RR=1.45: 95% CI, 1.03-2.03) P =0.032). Similar results were obtained by Nair et al. [35], in a UK national case–control study on factors associated with maternal death from direct pregnancy complications. They found six factors from direct pregnancy complications to be associated with maternal death: inadequate use of antenatal care; substance misuse; medical comorbidities; hypertensive disorders of pregnancy; previous pregnancy problems; and Indian ethnicity. In our study, there was no ethnic group with a higher risk of maternal death from pregnancy complications. The role of hypertensive disorders of pregnancy is becoming more and more important as a cause of maternal mortality. Studies have shown that hypertension in pregnancy increases the risk of

intracranial hemorrhage, eclampsia or end-organ dysfunction culminating in death[35].
The lack of magnesium sulphate and antihypertensive medications in some rural
localities in Mezam Division complicates the situation.

Place of delivery: Eighty-nine per cent of the total participants gave birth in a health
institution. This was higher than 61% obtained by the national census “L’Enquête
démographique et de Santé et Indicateurs Multiples du Cameroun (EDS-MICS) 2011
(2011)”. Those who delivered out of hospital settings were more likely to die from
pregnancy-related complications than those who delivered in the hospital. (RR= 2.44:
95% CI, 1.79-3.32; p-value =<0.0001). Similar results obtained by Yaya et al. in a
community-based study in Rural South Ethiopia reported that four of every five
maternal deaths occurred at home without the attention of the health facility of the
area[36] and Girma M et al.[37]. also reported that based on a population of 1.7 million
people, there should be 14 basic and four comprehensive emergency obstetric care
(EmOC) facilities in the Zone. Their study found that only three basic and two
comprehensive EmOC service qualifying facilities serve this large population which is
below the UN’s minimum recommendation. The utilization of the existing facilities for
delivery was also low, which is clearly inadequate to reduce maternal deaths to the MDG
target. In the Mezam Division, some localities are difficult to access and lack
transportation to take women to health facilities for delivery. The fact that women in
these localities usually wait for labour to be well advanced before seeking medical
attention could explain why some women deliver at home or on the way to a health
facility.

Healthcare provider: Eighty-nine per cent of participants received care from health
personnel. Those who received care from people other than health personnel were 2.87

times more likely to die from pregnancy-related complications than those who received care from health personnel (RR= 2.87: 95% CI, 2.17-3.79; P =<0.0001). This result was greater than the 64% obtained at national level by the demographic inquiry carried-out in Cameroon in 2011 (L'Enquête démographique et de Santé et Indicateurs Multiples du Cameroun (EDS-MICS) 2011 (2011))[38].

Hospital accessibility: Those who used more than one hour to reach the hospital were 1.42 times more likely to die from pregnancy-related complications than those who used less than that (RR=1.42: 95% CI, 1.01-1.99; p-value =0.041). In our study 39.7% of the women were unable to reach a health facility on time. Ghebehiet found 19%[21]. This difference could be ascribed to factors such as the geographical location, study setting, clinical characteristics of the study population and even study designs. However, similar results were obtained by Thaddeus et al. [8].

Study limitations

- ❖ The study was restricted to Mezam Division of the North West Region. The results could therefore not be generalized to the whole country because of the noted divergences in socio-demographic and socio-economic characteristics in the country and a lot more so among its women.
- ❖ We could not calculate the maternal mortality ratio during the study period because we could not get the exact number of live births.
- ❖ There was difficulty in tracing the dead woman's family in the community, sometimes because the death resulted in the family moving to another locality.
- ❖ The data for cases were not obtained from the deceased. It could therefore be unreliable. The respondents might have been tempted to present the situations in a more encouraging way in what is called "social desirability".

- ❖ There could also be underreporting of cases like early maternal death because of the difficulty in identifying early-pregnancy before the pregnancy is clearly recognized, and death due to abortions because abortion is illegal in Cameroon[39].
- ❖ Verbal autopsy is not 100% diagnostic of death, therefore the causes of death identified through this method might not be reliable.

Conclusion

Majority, 77.53% of maternal deaths were from direct causes, mainly post-partum haemorrhage (30.43%), unsafe abortion (26.09%) and hypertensive disorders in pregnancy (14.49%).

The main indirect causes of maternal mortality found in our study were severe malaria (26.31%) and HIV/AIDS (26.31%), followed by anaemia and lung disease, 15.79% each. Inadequate antenatal care, pre-existing medical co-morbidity, place of delivery, healthcare provider training and accessibility of health facility were other contributory factors of maternal death. The peak age range of maternal death was 20-24 years (24.72%) followed by 35-39 years,(21.35%).

Recommendations

The competence of medical staff that can carry out basic life-saving procedures should be improved, especially in the rural areas. By so doing, some obviously preventable causes of maternal death will be avoided. The defective referral-counter-referral system in our setting will also need to be revised. Reproductive health education should be enforced to encourage women to deliver in health facilities. Skilled community-based

birth attendants should be trained and posted to increase maternal coverage in remote areas.

A community death record should be kept to enable tracking of maternal mortality.

Periodic maternal mortality audits should be conducted to identify and correct lapses in reproductive health care.

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550 Table 1: Health Districts and number of Health Areas in Mezam division of the NWR.

District	Population	No. of health areas
Bamenda	345,869	17
Santa	73,418	9
Bafut	66,039	14
Tubah	55,357	11
Bali	34,629	7
Total	575,312	58

551

552 **Table 2: Yearly distribution of maternal mortality in health districts of Mezam.**

District	Population	No. cases per year					No. controls
		2011	2012	2013	2014	Tot	
Bamenda	345,869	15	8	10	13	46	92
Santa	73,418	2	3	3	4	12	24
Bafut	66,039	4	3	5	2	14	28
Tubah	55,357	2	2	4	2	10	20
Bali	34,629	2	2	0	3	7	14

<i>Total</i>	575,312	25	18	22	24	89	178
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Table 3: Socio-demographic characteristics of the participants

Characteristic	Cases (n=89)	Controls (n=178)	P value
Age(in years)			
<i>Mean±SD</i>	28.53±7.90	27.01±6.89	0.106
<i>Range</i>	15-42	15-43	
Marital status			
<i>Married</i>	51(57.3%)	115(64.6%)	0.246
<i>Unmarried</i>	38(42.7%)	63(35.4%)	
Occupation			
<i>Unemployed</i>	23(25.8%)	30(16.8%)	0.152
<i>Unskilled</i>	26(29.2%)	49(27.5%)	
<i>Skilled</i>	40(45.0%)	99(55.7%)	
Level of education			
<i>Non</i>	9(10.1%)	13(7.3%)	0.476
<i>Primary</i>	39(43.8%)	70(39.3%)	
<i>>primary</i>	41(46.1%)	95(53.4%)	
Religion			
<i>Christian</i>	85(95.5%)	162(91.0%)	0.188
<i>Muslim</i>	4(4.5%)	16(9.0%)	
Settlement			
<i>Rural</i>	46(51.7%)	92(51.7%)	1.0
<i>Urban</i>	43(48.3%)	86(48.3%)	
Best Means of Transport			
Foot	26(29.2%)	40(24.5%)	0.414

Moto-Bike	41(46.1%)	84(47.2)
Vehicle	22(24.7%)	54(30.3%)

555

556 **Table 4: Behavioural and obstetrics characteristics**

Characteristic	Cases (n=89)	Controls (n=178)	P value
Parity			
≤1	12(13.5%)	22(12.4%)	0.418
2-4	35(39.3%)	85(47.8%)	
≥5	42(47.2%)	71(37.8%)	
ANC			
Zero	23(25.8%)	19(10.7%)	0.002
1-2	30(33.7%)	56(31.4%)	
>2	36(40.5%)	103(57.9%)	
Presence of Comorbidity			
No	55(63.0%)	132(74.2%)	0.038
Yes	34(37.0%)	46(25.8%)	
Place of Delivery			
Hospital	68(76.4%)	169(95.0%)	<0.0001
Others	21(23.6%)	9(5.0%)	
Care Giver			
Health Personnel	64(71.9%)	171(96.1%)	<0.0001
Others	25(28.1%)	7(3.9%)	
Time to Arrive the Hospital			
<1hour	46(51.7%)	115(64.6%)	0.042

≥1hour 43(48.3%) 63(35.4%)

557

558 **Table 5: Age distribution of maternal mortality**

Age Years	Group	In	No. of Death	Percentage
15-19			12	13.48
20-24			22	24.72
25-29			16	17.98
30-34			12	13.48
35-39			19	21.35
≥40			8	8.99
Total			89	100

559

560 **Table 6: Bivariate analysis of socio-demographic and obstetric characteristics**
561 **associated with maternal mortality.**

Characteristic	Cases (n=89)	Controls (n=178)	Relative risk	95%CI	P value
Age(in years)					
<i>Modal age(20-24)*</i>	22(24.7%)	46(25.9%)	0.96	0.65- 1.43	0.843
Others	67(75.3%)	132(74.1%)			
Marital status					
<i>Married</i>	51(57.3%)	115(64.6%)	1.23	0.87- 1.72	0.242
<i>unmarried*</i>	38(42.7%)	63(35.4%)			
Occupation					
<i>unemployed*</i>	23(25.8%)	30(16.8%)	1.41	0.97- 2.03	0.068
<i>Employed</i>	66(74.2%)	148(83.2%)			
Level of education					

<i>≤primary education*</i>	48(53.9%)	83(46.6%)	1.22	0.86-1.71	0.262
<i>>primary education</i>	41(46.1%)	95(53.4%)			
Religion					
<i>Christian*</i>	85(95.5%)	162(91.0%)	1.72	0.70-4.20	0.234
<i>Muslim</i>	4(4.5%)	16(9.0%)			
Settlement					
<i>Rural*</i>	46(51.7%)	92(51.7%)	1.00	0.71-1.40	1.000
<i>Urban</i>	43(48.3%)	86(48.3%)			
Parity					
<i><5</i>	47(52.8%)	107(62.2%)	1.22	0.87-1.71	0.253
<i>≥5*</i>	42(47.2%)	71(37.8%)			
ANC					
<i>Zero(unbooked)*</i>	23(25.8%)	19(10.7%)	1.87	1.33-2.63	0.0003
<i>≥1</i>	66(74.2%)	159(89.3%)			
Presence of Comorbidity					
<i>No</i>	55(63.0%)	132(74.2%)	1.45	1.03-2.03	0.032
<i>Yes*</i>	34(37.0%)	46(25.8%)			
Place of Delivery					
<i>Hospital</i>	68(76.4%)	169(95.0%)	2.44	1.79-3.32	<0.0001
<i>Others*</i>	21(23.6%)	9(5.0%)			
Healthcare provider during delivery					
<i>Health Personnel</i>	64(71.9%)	171(96.1%)			

<i>Others*</i>	25(28.1%)	7(3.9%)	2.87	2.17-3.79	<0.0001
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Time to Arrive the Hospital

<i><1hour</i>	46(51.7%)	115(64.6%)	1.42	1.01-1.99	0.041
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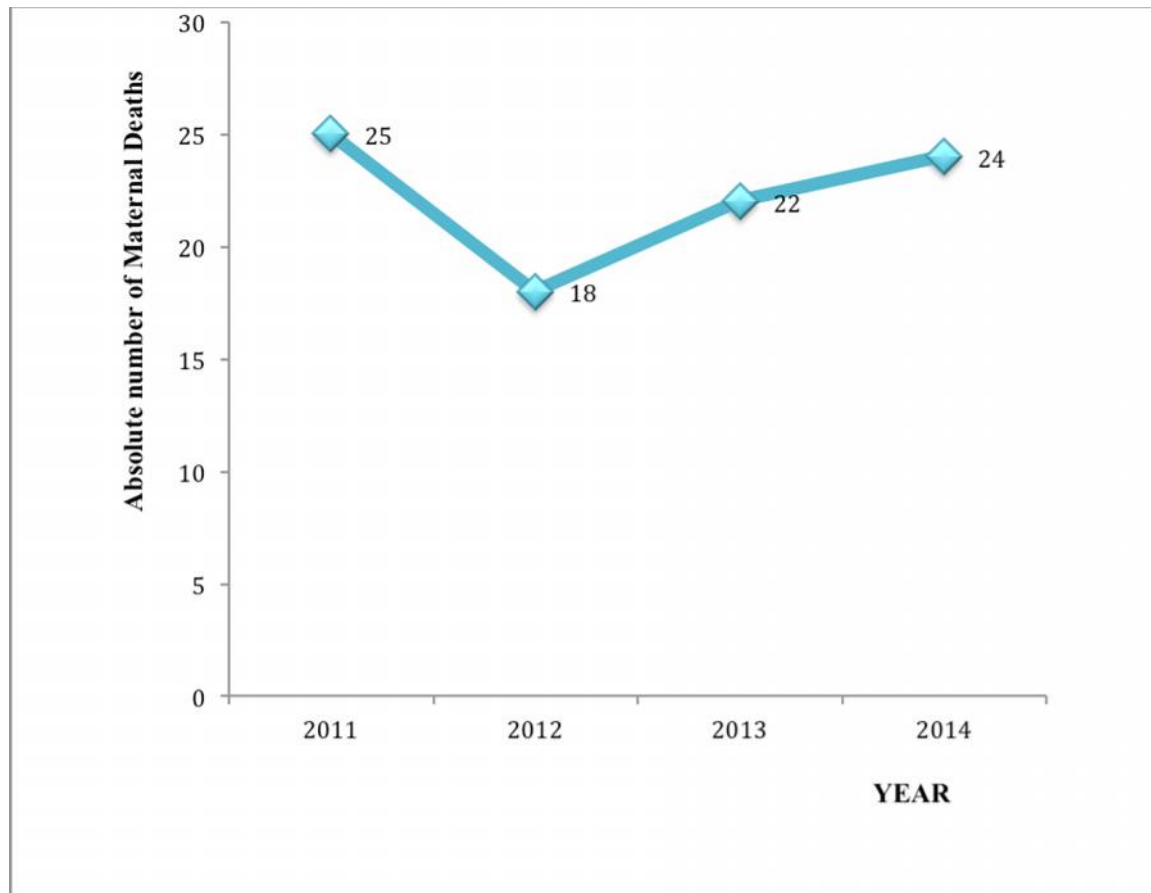
<i>≥1hour*</i>	43(48.3%)	63(35.4%)
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*Characteristic used as reference.



Figure 1 : Map of the North-West Region, Cameroon locating the Mezam Division

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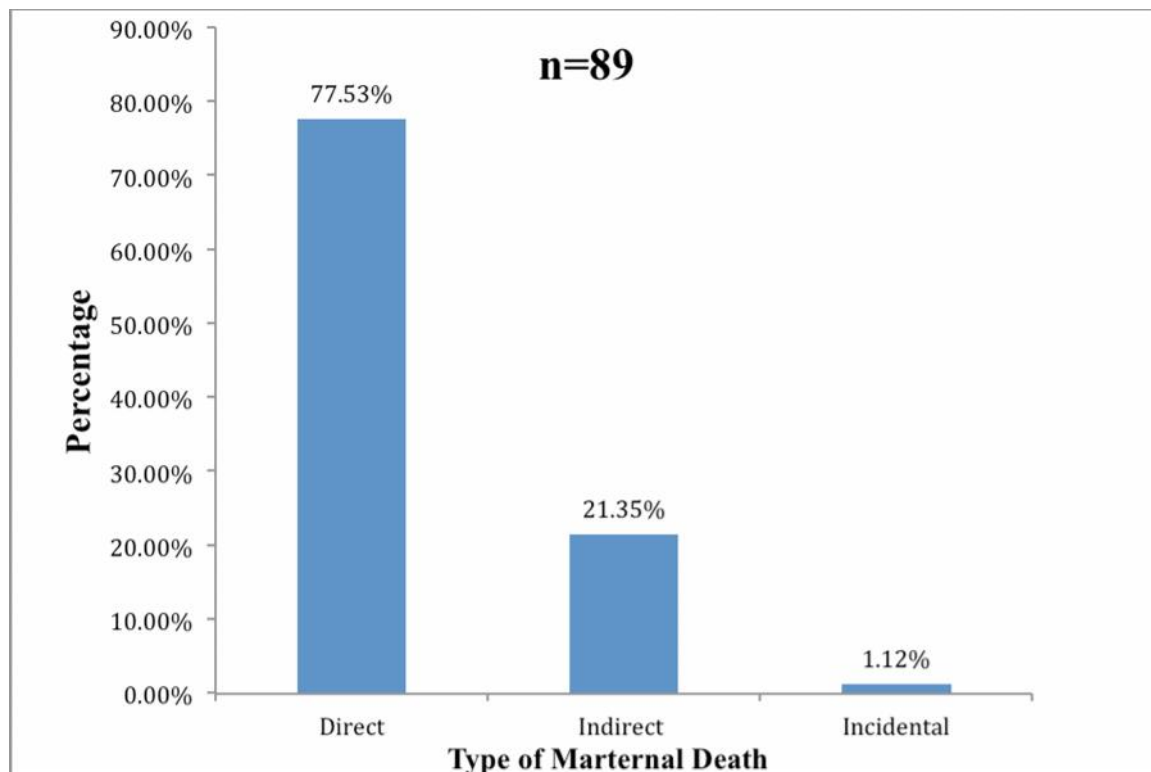
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575 **Figure 1: Trend in yearly absolute number of Maternal Deaths in Mezam**

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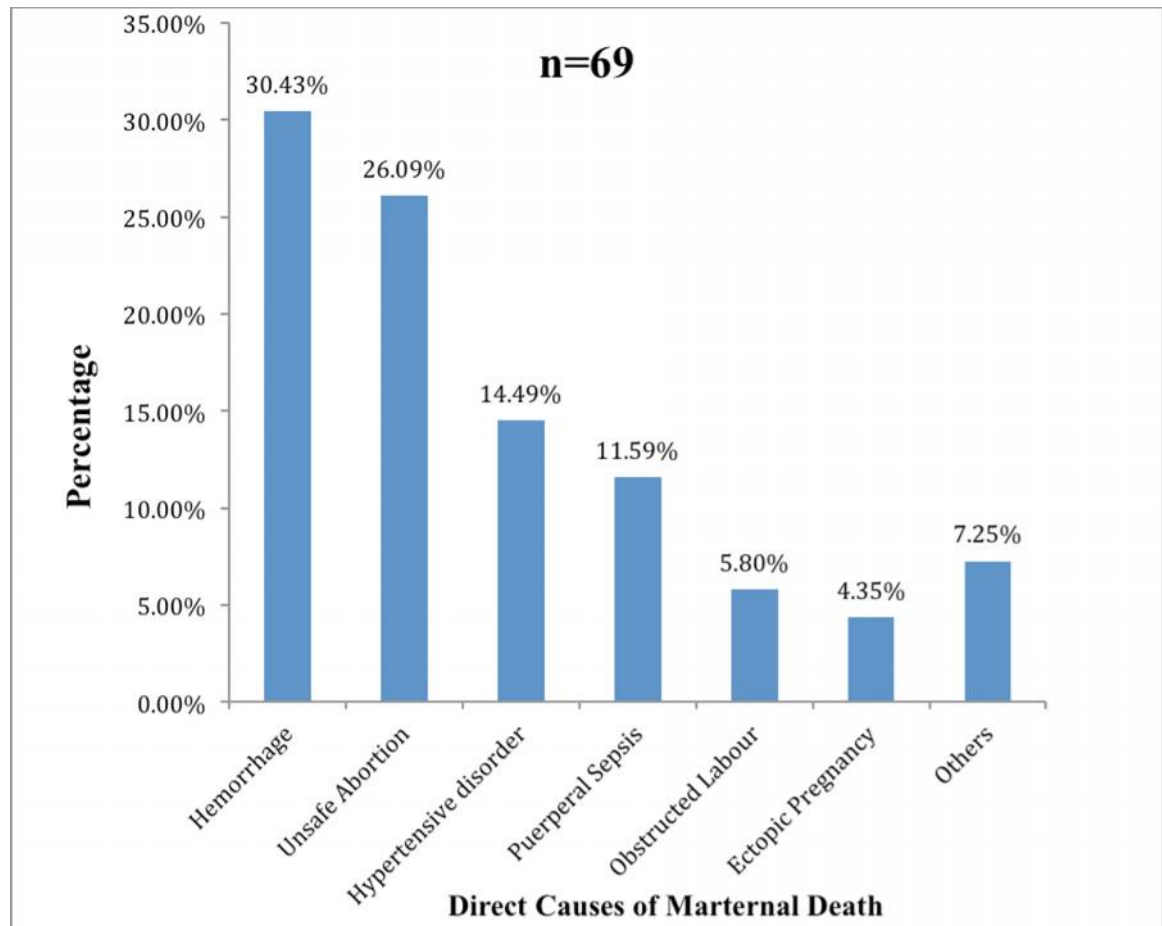
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581 **Figure 2: Causes of maternal mortality.**

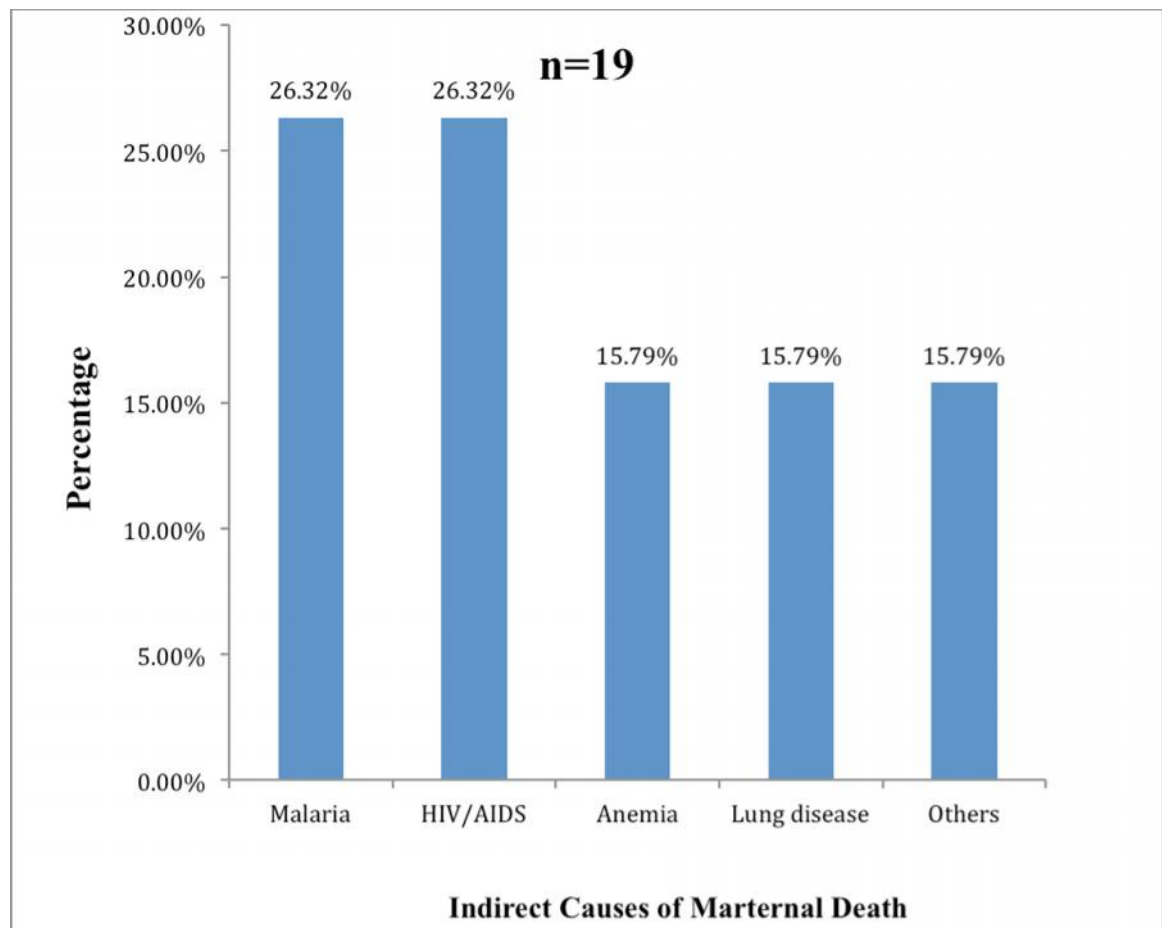
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585 Figure 3: Direct causes of maternal mortality.

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592 Figure 4: Indirect causes of maternal mortality