DETERMINANTS OF MATERNAL DEATHS IN THE EASTERN REGION OF GHANA, 2011 – 2016

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Abstract

Introduction: An estimated 99% of largely preventable maternal deaths occur across developing regions characterized by a cascade of well-established delays at all levels. Data on community deaths remains scanty hence a wide reliance on institutional data. Target 3.1 of the SDG aims to attain a global reduction of less than 70/100000 live births by 2030. Ghana's MMR of 350/100000 live births is accounted for by commensurately high MMR across its 10 administrative regions. The MMR of the Eastern region, ranked among the top 5 by MMR, has exceeded the national average since 2011. Studies are largely cross sectional, not computing individual risk. This study aimed to (1) identify trends of institutional maternal deaths, (2) estimate magnitudes of individual risk with exposure to specific factors and (3) recommend preventive strategies.

Methodology: Records on 479 maternal deaths were compared with 616 records on obstetric clients over the same period that did not die from 2011 - 2016 using an unmatched case control study design. Data were analyzed with epi info 3.5.4.

Results: Maternal deaths were mainly direct. Controls were largely urban residents, with traceable addresses, engaged in formal occupations, of higher educational backgrounds and ANC attendants. Leading cause of death was obstetric hemorrhage. Most abortions, mainly cases, were unsafe. Mean maternal age was higher for cases. Maternal age of 11 - 20 and $\geq$ 35, rural residence, underlying medical conditions, informal occupations, multi- and grand multiparity increased risk of maternal deaths, while, $\geq$ SHS education and ANC $\geq$ 4 reduced risk of death.

Recommendations: Health policies to address concerns of fertility control for adolescents and clients $\geq$ 35, inequitable access to CEmONC services, quality ANC, low literacy and awareness on the abortion law should be prioritized.

Introduction

Maternal death, defined (by WHO and ICD-10) as death of a woman while pregnant or within 42 days after termination of pregnancy irrespective of the site or duration of the pregnancy from causes related to or aggravated by the pregnancy or its management but not from accidental or incidental causes[1], is a sensitive index of the strength of Health Service Delivery and socioeconomic development of state[2]. They are subdivided into *direct* (from obstetric complications of the pregnant state, interventions, omissions, incorrect treatment and/or from a chain of events resulting from any of the above) and *indirect* (from previously existing morbidity, or morbidity developing during pregnancy, not attributed to direct obstetric causes but aggravated by physiologic effects of pregnancy)[2]. MMR is of immense public health importance and comprises a key maternal health performance indicator[3] *with the largest disparities between developed and developing countries*[4]. An estimated 99% occur in developing regions of the world where an estimated 98% are deemed preventable[5]; Southern Asia and Sub-Saharan

African countries account for an estimated 85% of the global burden[3]. Increased access to family planning (FP), skilled birth attendance and **Emergency Obstetric Care (EOC)** have contributed to global reductions from 380 in 1990 to 210 per 100,000 live births in 2013[3]. Categorized causative factors include socio-economic, socio-cultural, socio-demographic and medical explanatory factors[6].

While accurate estimates remain difficult due to data paucity in varying proportions[7], data on institutional deaths remains the only readily available data source. Ghana is globally ranked 32nd with an estimated MMR of 350/100000 live births[8]. MMR in Eastern Region has exceeded the national average since 2011. Studies in Ghana have largely been cross sectional while studies to estimation individual risk of maternal death with exposure to specific risk factors (to advance causality consistently with Sir Austin Bradford Hills's criteria) remains scarce. This study aimed to (1) identify trends of institutional maternal deaths, (2) estimate magnitudes of individual risk with exposure specific factors and (3) make recommendations for prevention.

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Materials and Methods

The study was completed through a record review of all institutional maternal deaths in the Eastern Region from 2011 – 2016. Cases comprised institutional maternal deaths 2011 - 2016 selected through non-

probability sampling. A total 479 deaths were selected from 526 records through non-probability sampling. Deaths that occurred on the way to health facilities were excluded. Referred cases whose demise occurred prior to arrival to the referral health facility were included (i.e. deemed cases of the referral facilities). Controls were patients who sought obstetric services from the same health facilities (where cases occurred) but did not die. They were traced through admission and discharge registers on maternity wards and further traced through the health records units for retrieval of their folders for data abstraction. Two patients who sought obstetric care and were managed as inpatients on the day of the demise of cases were selected as controls if their folders could be traced and retrieved; one control was selected if other folders could not be traced. A total 616 controls were included as controls. Causes of death were classified in accordance with coding guidelines of ICD-10 MM for deaths during pregnancy, childbirth and the puerperium. Data were analyzed with Epi info 3.5.4.

Results

An estimated 71.5% of the maternal deaths were direct. Mean maternal age of cases was higher and showed a higher variance than controls. See table 1.

Table 1. Maternal Age Characteristics of Cases and Controls

Characteristic	Cases	Control
Mean Maternal Age	29.43	27.6
Median	29.5	27
Standard Deviation	7.2296	4.3606
Variance	52.2673	19.0147

Controls were largely urban residents with traceable addresses, engaged in formal occupations and had partners/spouses also engaged in formal occupation types. See table 2.

Table 2. Residence, Address Traceability and Occupations of Cases and Controls

Characteristic	Cases	Control
	N (%)	N (%)
Area of Residence		
Urban	165 (42.9)	190 (66.4)
Rural	220 (57.1)	96 (33.6)
Address Traceability		
Traceable	283 (60.3)	243 (82.7)
Not Traceable	186 (39.7)	48 (17.3)
Clients' Occupation Types		
Formal	27 (6.4)	30 (12.7)
Informal	394 (93.6)	207 (87.3)
Partners' Occupation Types		
Formal	16 (9.4)	34 (14.2)
Informal	154 (90.6)	205 (85.8)

Comparatively more maternal deaths occurred among clients with no prior exposure to formal education, primary and Junior High School (JHS) educational backgrounds. See table 3.0.

Table 3. Educational Backgrounds for Cases and Controls

Highest Education Attained	Cases	Control
	N (%)	N (%)
Nil	92 (20.77)	6 (2.4)
Primary	93 (20.9)	12 (4.7)
JHS	208 (46.7)	166 (65.6)
SHS	31 (7)	38 (15)
Tertiary	21 (4.7)	31 (12.3)

More controls than cases had had normal vaginal deliveries i.e. 73.1% and 30.6% respectively. An estimated 31.7% of cases delivered by cesarean section (CS) compared with 22.2% of controls who delivered by CS. While 10.4% of cases had abortive pregnancy outcomes, about 4.7% abortions were observed among controls. An estimated 27.2% of cases however died without expulsion of the conceptus i.e. died with *conceptus in utero*.

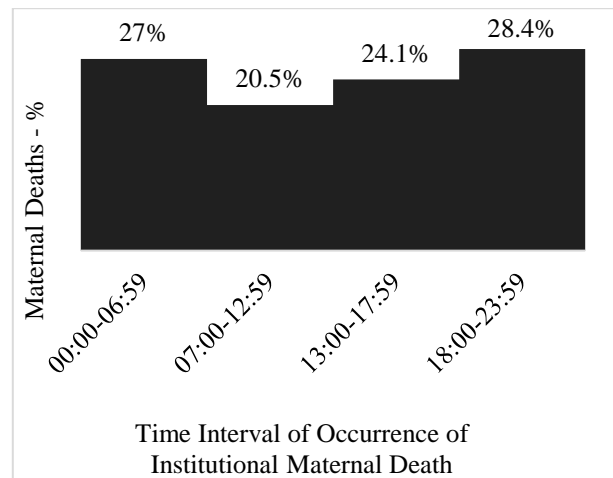More maternal deaths were marginally observed to have occurred before 07:00 GMT and/or after 18:00 GMT. See fig. 1.

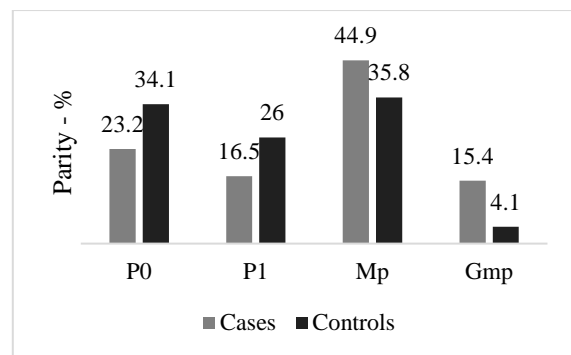**Fig. 1.** General Times of Occurrence of Maternal Deaths in the Eastern Region

Fig. 1. Parity Patterns of Cases and Controls
P0 – nulliparous, P1 – uniparous, Mp – multiparity, Gmp – grand multiparity

Mean gravidity was comparatively higher for cases; more deaths were observed among multiparous and grand multiparous women. See fig. 2.

Unsafe abortions among cases accounted for 50% of adverse pregnancy outcomes for clients 11 – 15 years, 41.2% of clients 16 – 20 years and 100% of patients 41 – 49 years before 28 completed weeks of gestation.

Bivariate analyses suggested that clients aged 11 – 15 years had a marginally increased risk of maternal death; the 95% CI was significant towards the null. Risk of maternal death significantly increased for females 16 – 20 years while clients 21 – 35 years had significantly reduced risk of all-cause maternal death. See table 4.0. Urban residents, who largely had traceable addresses and clients of formal occupation types had significantly reduced risk of maternal deaths. See table 5. Patients with no exposure to formal education and patients of primary school educational background had

Table 4. Risk of Maternal Death Analysed by Maternal Ages of Cases and Controls

Maternal Age Group	Cases (N=479) N (Col %)	Controls (N=616) N (Col %)	OR (95% CI)	P-value
11 – 15 Yes No	8 (80) 468 (43.3)	2 (20) 614 (56.7)	5.2 (1.1 – 24.8)	0.02
16 – 20 Yes No	49 (62.8) 427 (42.1)	29 (37.2) 587 (57.9)	2.3 (1.4 – 3.7)	0.0005
21-25 Yes No	98 (35.9) 378 (46.2)	175 (64.1) 441 (53.8)	0.6 (0.4 – 0.8)	0.004
26-30 Yes No	115 (32.5) 266 (54.3)	239 (67.5) 224 (45.7)	0.5 (0.3 – 0.6)	0.0001
31-35 Yes No	95 (38.3) 318 (45.1)	153 (61.7) 463 (54.9)	0.7 (0.5 – 0.9)	0.07
36-40 Yes No	87 (86.1) 389 (39.3)	14 (13.9) 602 (60.7)	9.6 (5.3 – 17.7)	0.0001
41-45 Yes No	3 (75) 473 (43.5)	1 (25) 615 (56.5)	9.4 (2.1 - 31)	0.0002

Table 5. Risk of Maternal Death Analyzed by Area of Residence, Address Traceability, Marital Status and Occupations

Variable	Cases (N=479) N (Col %)	Controls (N=616) N (Col %)	OR (95% CI)	P-value
Area of Residence Urban Rural	165 (42.9) 220 (57.1)	190 (66.4) 96 (33.6)	0.4 (0.3 – 0.5)	0.00001
Patient's Occupation Formal Informal	27 (6.4) 394 (93.6)	30 (12.7) 207 (87.3)	0.5 (0.3 – 0.8)	0.001
Partner's Occupation Formal Informal	16 (9.4) 154 (90.6)	34 (14.2) 205 (85.8)	0.6 (0.3 – 1.2)	0.2
Marital Status Single/unclear Married/Cohab.	100 (71.9) 371 (61)	39 (28.1) 237 (39)	1.6 (1.09 – 2.4)	0.02

significantly increased risk of maternal death. Risk of maternal death however reduced significantly with exposure to JHS, SHS and Tertiary educational backgrounds. See table 6.0. ANC attendance, irrespective of number of attendances, marginally reduced risk of maternal death. ANC of ≥ 4 attendances however significantly reduced risk of death. See table 7.0 below. Multiparity and grand multiparty status increased the risk of maternal death. See table 8.0.

Table 6: Risk of Maternal Deaths by Clients' Highest Education Attained

Highest Education Attained	Cases (N=479) N (Col %)	Controls (N=616) N (Col %)	OR (95% CI)	P-value
Nil Yes No	92 (88.5) 353 (57.2)	12 (11.5) 264 (42.8)	5.3 (2.8 - 10)	0.0000001
Primary Yes No	93 (76.2) 352 (58.8)	29 (23.8) 247 (41.2)	2.2 (1.4 – 3.5)	0.0004
JHS Yes No	208 (55.6) 237 (68.3)	166 (44.4) 110 (31.7)	0.5 (0.4 – 0.7)	0.0006
SHS Yes No	31 (44.9) 414 (63.5)	38 (55.1) 238 (36.5)	0.4 (0.2 – 0.7)	0.0003
Tertiary Yes No	21 (40.4) 424 (63.4)	31 (59.6) 245 (36.6)	0.3 (0.2 – 0.6)	0.001

Table 7: Risk of Maternal Deaths by Antenatal Clinic Attendance Status

ANC Status	Cases (N=479) N (Col %)	Controls (N=616) N (Col %)	OR (95% CI)	P-value
ANC Status Yes No	362 (58.9) 92 (87.6)	253 (41.1) 13 (12.4)	0.2 (0.11 – 0.3)	0.002
ANC ≥ 4 Yes No	211 (48.3) 134 (87.6)	226 (51.7) 19 (12.4)	0.13 (0.07 – 0.2)	0.0000001

Table 8: Risk of Maternal Deaths by Patients' Parity

Parity	Cases (N=479) N (Col %)	Controls (N=616) N (Col %)	OR (95% CI)	P-value
Para 0 Yes No	107 (56) 354 (68.6)	84 (44) 162 (31.4)	0.5 (0.4 – 0.8)	0.002
Para 1 Yes No	76 (54.3) 385 (67.9)	64 (45.7) 182 (32.1)	0.5 (0.3 – 0.8)	0.003
Multip. Yes No	207 (70.2) 254 (61.7)	88 (29.8) 158 (38.3)	1.4 (1.06 – 2.0)	0.02
G - Multip. Yes No	71 (87.7) 390 (62.3)	10 (12.3) 236 (37.7)	4.2 (2.1 – 8.4)	0.00001

Emergency caesarean sections increased the risk of maternal death, OR - 3.4 (95% CI = 2.5 - 4.6), while elective caesarean sections were associated with significantly reduced risk of death, OR - 0.25 (95% CI = 0.12 - 0.5). All underlying medical conditions or pre-existing history of other illnesses i.e. medical explanatory factors documented in audit forms as causes of death were associated with significantly increased risk of maternal deaths. They included the following: malaria OR - 4 (95% CI = 1.6 - 10), anaemia OR – 3.9 (95% CI = 2.3 -4.3), HPT disease of pregnancy OR - 5 (95% CI = 3.3 - 7.4), PPH - SCD OR - 35 (95% CI = 4.8 - 257), unsafe abortion OR - 2 (95% CI = 1.4 - 4.7), sepsis OR - 24 (95% CI = 9 - 60), HIV/AIDS OR - 3 (95% CI = 1.6 - 7.1), APH OR - 4 (95% CI = 1.5 - 11), IUFD OR - 13 (95% CI = 4 - 44), gestational diabetes OR - 5 (95% CI = 1.1 - 24) and ectopic gestation OR – 0.8 (95% CI = 0.3 – 1.9).

Discussion

Maternal death, a largely preventable statistically rare health outcome, [9, 10] continues to occur despite several preventive interventions[11, 12, and 13]. Institutional maternal deaths were largely direct, consistent with findings of extant evidence base on Sub Saharan Africa and Southern Asia [9, 10, 11, 12, 14, 15, 16, 17 and 18]. Mean maternal age was higher of cases and had wider SD. Clients of 11 - 20 and 36 - 49 years had a significantly increased risk of death during pregnancy consistent with findings of existence evidence base[19, 20]. Few studies however make contrary statements concluding that risk of adolescence is exaggerated though focus on reducing adolescent pregnancy (central to promotion of women's social, educational and economic development)[21] should to be maintained. Available evidence link established associations between rural residence and increased risk of deaths to adverse socio-cultural factors, poor access to quality ANC, poor referral systems and inadequate staff capacity for early problem detection and intervention.[22] A formal occupation for clients and their partners predicted favourable pregnancy outcomes for both mother and baby; this was interpreted as a remote indicator of the importance of individual socio-economic status for maternal health.[22] WHO indicates that majority of maternal deaths occur in low-resource settings[22]. Links between higher education and better health outcomes are established in extant evidence. Increasing education commensurately reduced the risk of maternal deaths, consistent with current evidence that the right to health is interdependently enhanced by the right to education.[23] Observation of higher proportions of CS among cases needs to be interpreted within the context of obstetric complications that necessitated them (and their severity thereof) to prevent categorization of CS as an independent death causal factor. Most maternal deaths occurred in advanced pregnancy consistent with findings of the Ghana maternal health survey, 2007[19].
Though the use of institutional data may have skewed maternal death occurrence towards late pregnancy,

the Ghana Maternal Health Survey indicates most maternal deaths occur shortly before labour, during labour and within the first 24 hours after delivery.[19]More deaths occurred in the evening and at dawn.
ANC of ≥4 visits improved maternal survival despite few contrary findings suggesting certain urban areas with high ANC and skilled delivery have high mortality ratios.[6] Geographical location of ANC services however has direct impact on patronage of any particular service.[6] ANC helps prevent mortality through prevention, identification and management of maternal morbidity.[24]Mean gravidity and parity were generally higher for cases and risk of maternal death increased commensurately with increasing parity. Risk of gravidity and parity needs to be interpreted carefully as they may not be independent risk factors. Records on gravidity and parity remained inaccurate in the available documentation - ANC booklets displayed inconsistent information on gravidity and parity for the same patients. Health worker knowledge on gravidity and parity should be prioritize for research. Obstetric haemorrhage remains the leading cause of maternal deaths across other developing countries[19]. HPT disorders of pregnancy are second in this series. Abortions, observed mainly among cases, were largely unsafe and mainly occurred among adolescents and clients of advanced maternal age contrary to findings of Ghana Maternal Health Survey[19]. Induced abortion evokes passion and controversy bordering on religion, culture, ethics and morality[13] and is largely frowned upon in some cultural and religious contexts therefore being resorted to clandestinely.[13] Only 4% of women in Ghana think that abortion is legal.[19] The 1985 amendment of Ghana's 1960 criminal code allowed abortion for rape, incest, defilement of the female idiot," where there is high risk that the child would suffer serious deformity and if the pregnancy threatens the woman's physical or mental health.[19].

Conclusion

An estimated 71.5% of the maternal deaths were direct. Mean age of cases was higher than controls. Risk of maternal death was higher for adolescents and clients of advanced maternal age than clients of other age categories. Urban residence, formal occupations, marriage/cohabitation with partners of formal occupations, ANC of ≥ 4 visits and education of ≥ SHS background significantly reduced risk of death during pregnancy or delivery. Abortions mainly occurred among cases; majority were consistent with unsafe abortion procedures. Comparatively more maternal deaths occurred between 06:59 GMT and after 18:00 GMT. Multiparity and grand multiparity increased risk of maternal death. Obstetric haemorrhage was the leading cause of maternal death while second and third in this series were HPT disorders of pregnancy and pregnancies with abortive outcomes.

Recommendations

Health policies aimed at increasing FP and sex education targeting sexually active adolescents coupled with intensified campaigns for adolescent sexual abstinence should be prioritized. Clients of advanced maternal age should be a priority group for long term FP methods towards prevention of unwanted, unplanned and mistimed pregnancies. ANC services in Ghana are accessible at community clinics (CHPS) with midwives, health centres and district hospitals. *B- & CEmONC* services needed to avert mortality are however only available at district hospitals and few polyclinics. Health policy should therefore aim to eliminate all inequalities in access to *B- & CEmONC* services for rural and urban residents. The National Health Insurance Scheme was rolled out to universally eliminate financial barriers to health care. Findings indicating reduced risk of death with formal occupation point to existence of socio-economic barriers other than what NHIA aimed to eliminate; this should be a research priority. The impact of the free SHS educational Policy, 2017 (aimed to universally eliminate all financial barriers to SHS education) on maternal health should be a research priority after 3 - 4 years of its implementation as education reduced risk of death in this study. Despite their statistically insignificant associations, findings descriptively suggesting marginally more deaths occurred after 18:00 GMT and before 06:00 GMT should be further hypothesized and tested as the statistically insignificant associations do not confer on us the liberty to ignore what descriptive analyses suggest. Factors inhibiting $\geq$ 4 ANC visits should be investigated and ameliorated within program frameworks. Efforts to increase proportions of women currently using FP methods should intensified – Ghana has FP coverage of 21%. Capacities of peripheral health facilities, largely serving rural residents, to avert mortality through *B- and CEmONC* services should be reviewed and enhanced.

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