ORIGINAL RESEARCH ARTICLE

When do maternal deaths occur? - A 3-year retrospective analysis of timing and seasonality of maternal deaths at the Korle Bu Teaching Hospital, Ghana

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Abstract

Maternal mortality remains a major public health challenge, particularly in low- and middle-income countries such as Ghana. There is limited data on timing and seasonality of maternal deaths particularly from the Sub-Saharan African region. This study examined the timing and seasonality of maternal deaths at Korle Bu Teaching Hospital, Accra, Ghana from January 2021 to December 2023. The maternal mortality ratio (MMR) was 801.3 per 100,000 live births over the period. A higher proportion of maternal deaths occurred during weekends, with Saturdays recording the highest percentage (18.5%). Deaths during night shifts accounted for 55.1% of all cases. Significantly higher proportion of maternal deaths occurred during the wet season ($p < 0.001$). On a month-by-month comparison, December recorded the highest MMR (1,142.1 per 100,000 live births), while November had the lowest (410.1 per 100,000 live births). More maternal deaths occurred during the night shift, weekends, wet and holiday-dense seasons. *(Afr J Reprod Health 2026; 30 [1]: 21-28).*

Keywords: Maternal mortality, Ghana, seasonality, emergency obstetric care, healthcare resource allocation

Résumé

La mortalité maternelle demeure un problème majeur de santé publique, en particulier dans les pays à revenu faible ou intermédiaire comme le Ghana. Les données sur le calendrier et la saisonnalité des décès maternels, notamment en Afrique subsaharienne, sont limitées. Cette étude a examiné le calendrier et la saisonnalité des décès maternels à l'hôpital universitaire Korle Bu d'Accra, au Ghana, de janvier 2021 à décembre 2023. Le taux de mortalité maternelle (TMM) était de 801,3 pour 100 000 naissances vivantes sur cette période. Une proportion plus élevée de décès maternels est survenue pendant les week-ends, le samedi enregistrant le pourcentage le plus élevé (18,5 %). Les décès survenus pendant les gardes de nuit représentaient 55,1 % de tous les cas. Une proportion significativement plus élevée de décès maternels est survenue pendant la saison des pluies ($p < 0,001$). En comparant les données mensuelles, décembre a enregistré le taux de mortalité maternelle le plus élevé (1 142,1 pour 100 000 naissances vivantes), tandis que novembre a affiché le plus bas (410,1 pour 100 000 naissances vivantes). On a observé davantage de décès maternels pendant les gardes de nuit, les week-ends, la saison des pluies et les périodes de forte affluence touristique. *(Afr J Reprod Health 2026; 30 [1]: 21-28).*

Mots-clés : Mortalité maternelle, Ghana, saisonnalité, soins obstétriques d'urgence, allocation des ressources de santé.

Introduction

Maternal mortality remains a critical public health challenge globally, with low- and middle-income countries (LMICs) disproportionately affected. Sub-Saharan Africa accounts for over 65% of maternal deaths globally, making it the region with the highest burden. Ghana, a lower-middle-income country in this region, recorded a maternal mortality ratio (MMR) of approximately 234 per 100,000 live births as of 2023.[1] While considerable progress has been made in improving maternal health through initiatives including the Millennium Development Goals (MDGs) and now the Sustainable Development Goals (SDGs), the rate of decline in maternal mortality has been slow and uneven across

various regions of the world. Seasonal variations in maternal mortality have been observed across some LMICs and appear to be influenced by multifaceted factors, including infectious diseases, food insecurity, and barriers to healthcare access during particular times of the year.[2] The timing of maternal mortality in relation to weekday or weekend, has been studied mostly in advanced countries, but less so in lower income settings, where it is unclear whether this relates to access or staffing.

In Ghana, the seasons are divided into the wet and dry seasons. The wet season is associated with the rains, and in Southern Ghana where the study site is situated, spans March to June and September to November, whiles the dry season spans July to August, and December to February. Hypertensive disorders, a leading cause of maternal mortality in Ghana, are often exacerbated by seasonal factors, such as the unavailability of adequate nutritional resources.[3–5] Additionally, seasonal variations in household income due to disrupted agricultural and economic activities can potentially impact ability to afford transportation to hospital, or healthcare services leading to delays in seeking emergency obstetric care. While various efforts to address maternal mortality in Ghana have focused on strengthening healthcare systems, improving antenatal care attendance, and expanding access to emergency obstetric care, these interventions have been unable to fully address the seasonal and temporal variations in maternal deaths. Understanding the timing of maternal deaths with respect to weekday versus weekend, day versus night work shift and their seasonal patterns is essential to inform appropriate policy for preventing maternal deaths.

This study therefore sought to examine these temporal distributions of maternal deaths and possible associated factors with the view to providing evidence that informs context-specific interventions for preventing maternal deaths in Ghana and other SSA settings.

Methods

Study site and patient population

This was a retrospective review of audited maternal deaths between January 2021 and December 2023 at the Korle Bu Teaching Hospital, Accra, Ghana. Korle Bu Teaching Hospital is the largest tertiary healthcare referral facility in Ghana and receives obstetric cases from across the country.

The maternity unit comprises 400 beds, two labour wards with a combined total of 20 labour and delivery beds, three operating theatres, and one recovery ward. The departmental workforce comprises 20 Consultant Obstetrician Gynaecologists, 30 Specialists, 35 Residents, and 30 House Officers, supported by about 120 Nurses and Midwives of varying ranks and expertise delivering round-the-clock care seven days a week. The nurses and midwives run a 6 hourly shift in the daytime comprising of a 6-hour morning shift and a 6-hour afternoon shift whiles the night shift lasts for 12hours. The doctors are divided up into 5 teams each of which run a 24-hour duty day on a designated day of the week. The Maternity Unit performs nearly 7,000 deliveries each year, with an average 50% caesarean section rate. The study analysed the time shift of work, day of week and seasonality of maternal deaths and their relationship to the average maternal mortality ratio at the facility. All 162 maternal deaths that occurred at the hospital from January 2021 to December 2023 were included in the analysis. These cases were identified from the hospital records and the maternal death audit reports database.

Data collection

Data was retrieved from the electronic patient folders and maternal death audit reports in the facility. Variables of interest included socio-demographic characteristics such as age, parity, marital status, educational level and category of referring facility (Table 1); direct and indirect causes of maternal deaths (Table 2); day of the week of death and work shift at the time of death (Table 3); month of death with monthly maternal mortality ratio (Table 4); time of the week death occurred (weekend /weekday) and season of death compared with the average maternal mortality ratio (801.3) over the three-year period of the study (Table 5). Work shift was defined as the period between two nursing handing over sessions grouped as morning, afternoon and night shifts. The morning shift was between 8am to 2pm, afternoon shift was between 2pm to 8pm and the night shift was between 8pm to 8am.

Data analysis

The data retrieved was entered into Microsoft Excel (Office 2024), verified for completeness, cleaned, and subsequently exported to IBM SPSS (version 29.0.20) for statistical analysis. Socio-demographic parameters were summarised using descriptive statistics. Continuous variables were presented as means with standard deviations, while categorical variables were presented as frequencies and percentages. Chi-square test was used to evaluate the associations between work shift at time of death, weekday/weekend at time of death and season of death with a maternal mortality ratio above or below the three-year average MMR of 801 per 100,000 live births. A p-value of 0.05 was considered significant. The monthly maternal mortality ratios per 100,000 live births was calculated by dividing the number of maternal deaths per month by the total number of monthly live births recorded. The Institutional Review Board of Korle Bu Teaching Hospital approved the study (KBTH-IRB 000109/2024) and data was appropriately anonymized to ensure patient confidentiality.

Results

Overview

There was a total of 20,190 deliveries with 20,218 live births at the Korle Bu Teaching Hospital over the three-year period of the study (January 2021 to December 2023). The total maternal deaths over the period were 162, giving the average MMR of 801 per 100,000 live births. Majority of the maternal deaths [27.8% (45/162)] occurred in the age group 30-34 years (Table 1). Women delivering for the first and second times formed the majority [61.7% (100/162)] of maternal deaths over the period (Table 1). Direct obstetric causes accounted for majority, 81.5% (n=132) of these deaths (Table 2).

A large proportion of the maternal deaths 44.4% (72/162) were cases referred to Korle Bu Teaching Hospital from district hospitals.

Day of death

More maternal deaths occurred on weekends with the highest percentage 18.5% (n=30) occurring on Saturday whiles the least percentage occurred on Thursday, 9.9% (n=16) (p=0.431) (Tables 3 and 5). Collectively, the pre-weekend on Friday and the weekends Saturday and Sunday recorded high proportions of maternal deaths as shown in Table 3.

Work shift at time of death (morning, afternoon, night)

Most of the deaths 55.1% (n=70) occurred at night with the least occurring in the afternoon 19.7% (n=25) (p=0.195) (Tables 3 and 5).

Month of death

The highest number of deaths (n=18) occurred in December followed by January and May recording equal values (n=15) (Table 4). December also recorded the highest MMR of 1,142.1 per 100,000 live births, whiles that of January and May were 891.8 and 761.4 per 100,000 live births respectively (Table 4). The least number of deaths was in November (n=6) with an MMR of 410.1 per 100,000 live births (Table 4).

Season of death

A significant majority of maternal deaths occurred in the wet season (n=90), fewer deaths occurring in the dry season (n=72), (p=<0.001) (Table 5)

Discussion

This study reviewed the timing, day of the week distribution and seasonality of maternal deaths over a three-year period at the Korle Bu Teaching Hospital in Ghana. We found that more maternal deaths occurred during the night shift compared to day shift; over the weekends compared to weekdays and also significantly more during the wet season in southern Ghana.

Delays in seeking care, arriving for care, and receiving the provided care, known collectively as the "three delays," have been reported to contribute to preventable maternal deaths.[6] Transportation challenges may potentially contribute to the high proportion of nighttime maternal deaths particularly in situations where poor road infrastructure and limited availability of emergency transport services make it more difficult for pregnant women experiencing complications to reach healthcare facilities during nighttime hours. Daniels had similarly reported that delays in transportation at night are a significant barrier to accessing timely emergency obstetric care, often resulting in preventable maternal deaths.[7]

Table 1: Sociodemographic characteristics of maternal death cases

Average Age ± SD	31.77 ± 6.92	Educational level	Frequency (%)
		No Formal Education	7 (4.3)
Age Group (years)	Frequency (%)	Primary	22 (13.6)
15-19	8 (4.9)	Middle School/Junior High School	43 (26.5)
20-24	17 (10.5)	Secondary	53 (32.7)
25-29	30 (18.5)	Tertiary	37 (22.8)
30-34	45 (27.8)	Total	162 (100.0)
35-39	40 (24.7)		
40-44	20 (12.3)	Category of referring facility	Frequency (%)
>45	2 (1.2)	District Hospital	72 (44.4)
Total	162 (100.0)	Tertiary Hospital (KBTH Attendant)	35 (21.6)
		Private Hospital	28 (17.3)
Parity group	Frequency (%)	Regional Hospital	9 (5.6)
Parity >2	62 (38.3)	Polyclinic	7 (4.3)
Parity ≤2	100 (61.7)	Tertiary Hospital (Non-KBTH Attendant)	5 (3.1)
Total	162 (100.0)	Unreferred	4 (2.5)
		Maternity Home	2 (1.2)
Marital Status	Frequency (%)	Total	162 (100.0)
Co-Habiting	13 (8.0)		
Married	128 (79.0)		
Single	21 (13.0)		
Total	162 (100.0)		

Table 2: Causes of maternal deaths over three years from 2021 to 2023 in Korle Bu Teaching Hospital

Cause of death	Frequency (%)	Direct cause of death	Frequency (%)
Hypertensive disorder	66 (40.7)	Hypertensive disorder	66 (50.0)
Obstetric haemorrhage	46 (28.4)	Obstetric haemorrhage	46 (34.8)
Sickle cell disease	13 (8.0)	Unsafe abortion	10 (7.6)
Unsafe abortion	10 (6.2)	Pulmonary embolism	5 (3.8)
Pulmonary embolism	5 (3.1)	Puerperal sepsis	3 (2.3)
Pneumonia	4 (2.5)	[b]Others	2 (1.5)
HIV/AIDS	3 (1.9)	Total	132 (81.5%)
Puerperal sepsis	3 (1.9)		
Liver failure	2 (1.2)	Indirect cause of death	Frequency (%)
Peripartum cardiomyopathy	2 (1.2)	Sickle cell disease	13 (43.3)
[a]Others	8 (4.9)	Pneumonia	4 (13.3)
Total	162 (100.0)	HIV/AIDS	3 (10.0)
		Liver failure	2 (6.7)
		Peripartum cardiomyopathy	2 (6.7)
		[c]Others	6 (20.0)
		Total	30 (18.5%)

[a]Others- Brain haemorrhage- 1 (0.6); Cerebral abscess- 1 (0.6); Diabetic ketoacidosis- 1 (0.6); Hyperemesis gravidarum- 1 (0.6); Ruptured ectopic pregnancy- 1 (0.6); SARS-CoV-2- 1 (0.6); Sepsis- 1 (0.6); Severe malaria- 1 (0.6)
[b]Others- Hyperemesis gravidarum- 1 (0.8); Ruptured ectopic pregnancy- 1 (0.8)
[c]Others- Brain haemorrhage- 1 (3.3); Cerebral abscess- 1 (3.3); Diabetic ketoacidosis- 1 (3.3); SARS-CoV-2- 1 (3.3); Sepsis- 1 (3.3); Severe malaria- 1 (3.3)

Table 3: Day of maternal deaths and work shift at time of maternal death over three years from 2021 to 2023 in Korle Bu Teaching Hospital

Day of death	Frequency (%)	Work shift at time of death	Frequency (%)
Saturday	30 (18.5)	Night	70 (55.1)
Sunday	25 (15.4)	Morning	32 (25.2)
Friday	25 (15.4)	Afternoon	25 (19.7)
Tuesday	25 (15.4)	Total	127 (100.0)
Monday	22 (13.6)		
Wednesday	19 (11.7)		
Thursday	16 (9.9)		
Total	162 (100.0)		

Table 4: Month of maternal deaths per maternal mortality ratio per 100,000 Live births over three years from 2021 to 2023 in Korle Bu Teaching Hospital

Month of death	Frequency (%)	Live Birth	MMR/100,000LB
November	6 (3.7)	1463	410.1
June	11 (6.8)	1887	582.9
March	12 (7.4)	1947	616.3
May	15 (9.3)	1970	761.4
September	12 (7.4)	1516	791.6
August	12 (7.4)	1472	815.2
July	14 (8.6)	1694	826.4
February	13 (8.0)	1556	835.5
October	13 (8.0)	1538	845.3
January	15 (9.3)	1682	891.8
April	21 (13.0)	1915	1096.6
December	18 (11.1)	1576	1142.1
Total	162 (100.0)	20216	801.3

Table 5: Association between temporal factors and a maternal mortality ratio above the three years average of 801 per 100,000 livebirths

	MMR >801		Total	p-value
Work shift at time of death	No	Yes		
Day	23	34	57	
Night	22	48	70	
Total	45	82	127	0.195
Time of the week death occurred	No	Yes		
Weekday	38	69	107	
Weekend	18	37	55	
Total	56	106	162	0.431
*Season of death	No	Yes		
Dry Season	0	72	72	
Wet Season	56	34	90	
Total	56	106	162	<0.001

* Season of death
Rainy season
Southern Ghana: March to June and September to November
Dry season
Southern Ghana: July to August and December to February

Due to these transportation challenges, the patients may likely arrive at the tertiary centre already moribund and thus resulting in the observed increased night shift maternal deaths. This is especially important given the high proportion of referral cases among maternal deaths.

The high pre-weekend (Fridays) and weekend (Saturdays and Sundays) maternal mortality shown in this study may be contributed to by inadequate human and other resource availability over these periods. Over the weekend and the night period, there are relatively fewer numbers of healthcare staff on the ground, majority of whom may be junior ranks, thus possibly leading to sub-optimal timely emergency care. A previous study by Adu-Bonsaffoh et al. suggested that understaffing and limited diagnostic capabilities at night may impact the timely management of obstetric complications, including postpartum hemorrhage and hypertensive crises, which are the two leading causes of maternal mortality at Korle Bu Teaching Hospital.[8]

Similarly, a 2024 report of the Kenyan Ministry of Health (MoH) and Amref Health Africa pointed out that seven out of 10 women who die from maternal health complications do so at night, on weekends or public holidays with 60-70% of the deaths occurring in referral hospitals.[9] Specifically, absenteeism by doctors, inadequate healthcare worker skills, insufficient drug administration, inadequate medical supplies and drugs, lack of blood and platelets, and the lack of transport between health facilities were the main reasons behind the maternal deaths in the Kenyan report.[9]

These observations underscore the need to streamline the key supply chain challenges in maternity units over the weekend and night shifts in a broader effort to tackle the contribution of unavailability of logistics to maternal mortality.

Typically, at the Korle Bu Teaching Hospital, on the maternity ward with averagely 50 obstetric in-patients, the week-day daytime shift has 13 doctors, 17 midwives/nurses, and 2-4 other professionals such as pharmacists and dieticians. The week-day night shift staffing comprises: 4 doctors and 6 midwives/nurses. The weekend daytime shift staffing has 8 doctors, 13 midwives/nurses while the night shift comprises 3 doctors and 5midwives/nurses. At the labour ward-and-theater suite, the typical week-day daytime professional care team comprises 7 doctors, 3-5 physician anesthetists and 55 midwives/nurses (including trainees), while the nighttime shift has 5 doctors, 14 midwives/nurses and two physician anesthetists. However, the weekend daytime shift staffing averagely consists of 5 doctors, 26 midwives/nurses (including trainees) and two physician assistant anesthetists (Certified registered anesthetists - CRAs), while the weekend night shift has: 4 doctors, 12 midwives/nurses (including trainees) and two physician assistant anesthetists (CRAs). Additionally, the night shift lasts 12 hours compared to the daytime which is divided into two 6 hourly shifts of morning and afternoon. The higher night mortality rate may therefore be associated with a 12-hour shift instead of the 6-hour morning or afternoon shift which may lead to fatigue resulting in delays or increased risk of errors in judgment. These reflect gross disparities in obstetric healthcare staffing across day versus night as well as weekday versus weekend shifts, which may likely be contributing to suboptimal emergency obstetric care and the resultant mortalities during these periods.

Consistent with the report by Lidigu et al., another plausible explanation for the relatively high mortalities at night and on weekends may relate to the limited availability of blood and blood products over this period, as well as the likelihood of delays in processing urgent requests and issuing the blood and blood products due to inadequate staffing. The blood bank at the maternity block is the main source of blood and blood products for obstetric emergencies and has the following staffing: weekday (daytime) – 2 medical laboratory scientists (MLS), nighttime shift – 1 MLS; weekend daytime shift – 1 MLS, nighttime shift – 1 MLS.

To further understand the disproportionately high maternal deaths over the weekends, the 'weekend effect' phenomenon has been suggested. A recent systematic review and meta-analysis that investigated the "weekend effect" of increased mortality rate during Saturday and/or Sunday admissions for hospitalized inpatients found that patients who were admitted on the weekends had a significantly higher overall mortality (RR- 1.19; 95% CI, 1.14-1.23).[10] Our study had the highest proportion of maternal deaths occurring on Saturdays. Consistent with our findings, Moaddab et al found that maternal mortality was significantly higher on weekends than weekdays (22.9 vs.

15.3/100,000 live births, $p < 0.001$).[11] Kim also found that weekend deliveries were 1.13 times significantly as likely to have any of seven maternal–neonatal adverse outcomes than weekday deliveries (OR 1.13, 95% CI 1.11-1.14).[12] Palmer *et al* also opined that there was a "weekend effect" in obstetric outcomes, revealing that 770 perinatal deaths and 470 maternal infections occur per year over weekends above what might be expected if performance was consistent across women admitted, and babies born, on different days of the week.[13] Contrary to our findings however, they did not find any consistent association between adverse obstetric outcomes and staffing numbers.[13]

Our study has demonstrated that significant number of maternal deaths occur in the wet seasons than in the dry seasons in agreement with some other studies in Africa where more deaths were recorded in the rainy season, linked with high malaria transmission.[14,15] Additionally, preeclampsia and eclampsia which are leading causes of institutional maternal mortality in Ghana[3], have been reported to demonstrate some seasonal increased incidence during the wet/rainy seasons in the tropical regions.[16–18] Specifically, the trigger of eclamptic seizures in the background of preeclampsia is said to arise from low atmospheric temperature and barometric pressure, high humidity and rainfall all of which characterize the rainy seasons.[19] However, other studies from South Sudan and Iran made contrary findings of more maternal deaths in the dry season.[20,21]

Even though the months of December and January fall within the dry season in Ghana, they carried high maternal mortality ratios per month. One of the plausible reasons is that there are more (at least 7 days in Ghana) holidays in December and January than other months. These holidays may be affecting antenatal care provision and resulting in disruptions in patient care that subsequently lead to more moribund obstetric emergencies with poorer outcomes. In addition, patients may be less motivated to seek early care for symptoms during the holiday season and may be traveling to see family away from the location of their antenatal care. Further, the number of deliveries is also low across both months, thereby increasing the month-by-month MMR for these two months.

Strengths and Limitations

Strengths

This study has examined a three-year dataset of maternal deaths, providing an initial analysis of trends in timing and seasonality and suggesting healthcare system (staffing and logistics) inefficiencies that offer practical opportunities for policy and clinical interventions.

The findings contribute to the broader discussion on maternal health in LMICs, particularly regarding the impact of night and weekend staffing, seasonality and systemic factors on maternal outcomes. To the best of our knowledge, this study is the first in Ghana to examine the timing and seasonality of maternal deaths with key findings to inform preventive interventions in Ghana and similar settings.

Limitations

The study is limited by the single centre nature, possibly limiting generalizability to other hospitals or regions in Ghana. However, Korle Bu Teaching Hospital being the largest referral centre in the country receiving high risk cases and serving a diverse ethnic patient population may provide outcomes reflecting a national picture.

The other inherent limitations is the retrospective design of the study which relies on already collected clinical data. In addition, the study did not explore healthcare providers' perspectives on nighttime and weekend staffing challenges. This qualitative component providing insights and perspectives on the timing and seasonality of maternal mortality would have added crucial angles for a more comprehensive understanding of the quantitative findings. Future studies may consider a mixed- methods approach to explore this aspect.

The potential policy implication of our findings is that there is a need for policy makers to focus on these vulnerable times and seasons (nighttime, weekends, wet and holiday seasons) with respect to staffing and other essential resource allocations. Additionally, the length of duration of nights shifts may be reviewed to minimize staff fatigue.

Conclusion

A high proportion of maternal deaths occurred during night shifts, weekends and the wet seasons at the Korle Bu Teaching Hospital in southern Ghana. Nighttime and weekend maternal deaths suggest systemic inefficiencies in essential logistic supplies and human resources for efficient emergency obstetric care provision. Targeted interventions, including improved healthcare staffing, enhanced emergency response mechanisms, and season-specific maternal health programs, are essential to reducing maternal deaths. Additionally, timeous referral from remote facilities to a higher level of care as well as more efficient ambulance services may significantly help in reducing maternal mortality.

Contribution of authors

Dr. Perez Sepenu (PS), Dr Theodore K. Boafor (TKB), Dr Promise Sefogah (PS), Dr. Naa Akushia Sepenu (NAS): Conception, Proposal writing, Data Collection and analysis, editing manuscript and approval of final manuscript. Dr. Ama Tamatey (AT), Dr. Michael Ntumy (MN), Dr. Emma Lawrence (EL), Dr. Latifatu Puumaya Alidu Yakubu (LPAY) and Dr. Nadia Glover-Addy (NGA): Proposal writing, Data Collection and analysis, editing manuscript and approval of final manuscript

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