

Stillbirth Rates in the Tamale Metropolis of Ghana

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Abstract The study estimated the stillbirth rates in the Tamale metropolis of Ghana over a five year period (from January, 2009 to June, 2013). It then investigated as to whether or not these rates significantly varied according to types and hospitals respectively. The study revealed that the average monthly number of births and stillbirths in the metropolis over the period were 580 and 13.92 respectively whilst the average number of macerated stillbirth and fresh stillbirth were 8.735 and 5.185 respectively. On the average, the highest number of births and still births were recorded in October and November respectively. Also there were no significant differences in the number of macerated and fresh stillbirths recorded over the period. The stillbirth rate for the metropolis from 2009 to 2011 ranged between 25.01 per 1000 births and 25.52 per 1000 births with a decline in these rates for 2012 (22.86 per 1000 births) and 2013 (21.91 per 1000 births). There were however significant differences in the total number of stillbirths recorded at the various hospitals in the metropolis over the period with Tamale central and Tamale teaching hospitals recording the lowest and highest the stillbirth rates respectively.

Keywords Stillbirth, Macerated, Fresh, Mann-Whitney, Kruskal-Wallis

1. Introduction

The need for accelerating progress towards the Millennium Development Goals (MDGs) 4 and 5 according to a policy brief released by the World Health Organization (WHO) in 2011, had increasingly been of concern to the international community as recognized within the Global Strategy for Women's and Children's Health launched by the United Nations Secretary-General in September 2010 [1-4]. To meet these MDGs, improved information is required at the global and programme levels to prioritize use of resources to achieve the maximum effect. Although stillbirth not included in tracking the MDGs, it is related to maternal mortality and with the care received during pregnancy and delivery [5]. The estimated trend in stillbirth rate reduction is slower than that for maternal mortality and lags behind the increasing progress in reducing deaths in children younger than 5 years [6]. Improved data on pregnancy outcomes including stillbirths are crucial to guiding programmes and investment towards progress in achieving the MDGs.

Stillbirth (also known as late fetal death) refers to death prior to the complete expulsion or extraction from their mother of a product of conception, after 28 weeks' of pregnancy (gestation) [7]. The death is indicated by the fact that after such separation, the fetus does not breathe or show any other evidence of life, such as beating of the heart,

pulsation of the umbilical cord, or definite movement of voluntary muscles. Stillbirth is a valuable health status indicator. A high stillbirth rate implicates maternal health and physique as a primary factor in mortality (and fertility). There are two types of stillbirths; *intrapartum* or fresh stillbirth and macerated stillbirth. A fresh stillbirth is a baby born dead without signs of skin disintegration or maceration and the death is assumed to have occurred less than 12 hours prior to delivery [6].

A number of studies on stillbirth have been carried out all over the world. Cousens *et al.* (2011) on their study of National, regional, and worldwide estimates of stillbirth rates in 2009 and a World Health Organization (WHO) policy brief on National, regional, and worldwide estimates of stillbirth rates in 2009 with trends since 1995 showed that the estimated number of global stillbirths was 2.64 million in 2009 and 3.03 million in 1995. These studies further revealed that worldwide stillbirth rate has declined by 14.5%, from 22.1 stillbirths per 1000 births in 1995 to 18.9 stillbirths per 1000 births in 2009. In 2009, 76.2% of stillbirths occurred in south Asia and sub-Saharan Africa. The study concluded that, most stillbirths were avoidable, as evidenced by the low stillbirth rate for developed countries of 3 per 1000 births in contrast to the stillbirth rate of 28 per 1000 births in sub-Saharan Africa [1, 8, 9].

Fitzpatrick and Cooper (2011) in their study of Patterns and trends in stillbirths and infant mortality in the United Kingdom discovered that stillbirth rate for the United Kingdom from 1991 to 1997 was 5.6 per 1,000 live births [10]. The stillbirth rate, the research further revealed varied across the different countries with Scotland recording the highest stillbirth rate of 6.2 per 1,000 births and Wales

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recording the lowest stillbirth rate of 5.4 per 1,000 births.

According to the Office for National Statistics (ONS) in England and Wales, there were 3,558 stillbirths in 2012 - a stillbirth rate of 4.9 per 1,000 live births. This had dropped from 5.3 in 2011 [11].

In Africa, Nigeria, Democratic Republic of Congo, Ethiopia and Tanzania are in the top League of Nations with high rates of stillbirths (with 42 stillbirths per 1000births for Nigeria and 26 stillbirths per 1000births for the rest) according to the first comprehensive set of stillbirth estimates, published recently in the medical journal The Lancet [12]. Ghana however had a stillbirth rate of 22 per 1000 births according to the report. This was further confirmed by Chalumeau et al (2002), who obtained the stillbirth rate in West Africa to be 26 per 1000 births [13].

In Ghana, the still birth rates seem to vary for the different region, districts and municipalities. For instance, the municipal profile of Techiman Municipality on the outcomes of delivering in the municipality from 2003-2005 indicated that; Still birth rate for 2005 was high (3.5%) as compared to that (2.4%) in 2004 [14]. Engmann *et al* in their study of Stillbirths and early neonatal mortality in rural Northern Ghana over a 7 year period revealed that the stillbirth rate rates in the Upper East region to be 23 stillbirths per1000 deliveries [15].

This study sought to estimate the stillbirth rates in the Tamale metropolis of Ghana and to investigate whether or not these rates significantly varied according to types and hospitals.

2. Materials and Methods

Secondary data on still birth for the Tamale metropolis was obtained from the Ghana health service district health information management (DHIMS) form January, 2009 to June, 2013.

The Tamale Metropolis is one of the 26 districts in the Northern Region and is among the six Metropolitan Assemblies in Ghana. It is located in the central part of the Northern Region and its capital is Tamale.

The metropolis has 47 health facilities comprising of; 11 chip zones and health centers, 10 clinics and maternity homes and 5 hospitals of which 2 are private. The government hospitals in the metro includes; Tamale Central Hospital, Tamale Teaching Hospital and Tamale West Hospital.

2.1. Stillbirth Rate

Stillbirth rate is a valuable health status indicator and a high stillbirth rate implicates maternal health and physique as a primary factor in mortality (and fertility). It is defined as;

$$\text{Stillbirth rate} = \frac{\text{stillbirth hs}}{\text{totalbirth hs}} \times 1000 \quad (1)$$

Where $\text{totalbirths} = \text{live births} + \text{stillbirths}$ [10].

2.2. Mann Whitney-Wilcoxon Rank Sum Test

To test whether the distribution of the number of stillbirths varied by type (macrated and the fresh stillbirths), the rank sum test was used to test the hypothesis that macrated and fresh stillbirths do not follow the same distribution or that there is a significant difference between the medians of the macrated and fresh still birth. Given x_1, x_2, \dots, x_n are random variables from a population having arbitrary but continuous distribution function F and y_1, y_2, \dots, y_n are independent and identically distributed random variables from a continuous distribution function G . For a large sample, the rank-sum statistic $\sum_{i=1}^n R(y_i)$ is asymptotically distributed as;

$$Z = \frac{\sum_{i=1}^n R(y_i) - \frac{n(N+1)}{2}}{[mn(N+1)/12]^{\frac{1}{2}}} \rightarrow N(0,1). \quad (2)$$

A large p - value in comparism to the significance level is an indication of the insignificance of the test.

2.3. The Kruskal-Wallis Test

Also, to find out if the number of still births varied according to the hospitals (Tamale Central Hospital, Tamale Teaching Hospital and Tamale West Hospital), the Kruskal-Wallis test was used to test the hypothesis that the different hospitals have the same distribution of the number of stillbirths. Let x_{ij} , $i = 1, 2, \dots, c$ and $j = 1, 2, \dots, n_i$ be c independent samples taken from c populations having continuous distribution functions; $F_1(x), F_2(x), \dots, F_c(x)$.

We test the hypothesis; $H_0: F_1 = F_2 = \dots = F_c$ or

H_0 : all the hospitals have identical distributions for stillbirth rate over the period against

H_1 : all the hospitals have identical distributions for stillbirth rate over the period.

The test statistic is based on the form in the ranks.

$$R_i = \sum_j R_{ij} = \sum_j R(x_{ij}),$$

Where $R(x_{ij})$ is the rank of x_{ij} in the combined ranking of all $N = \sum_{i=1}^c n_i$ observations and is given by;

$$H_{N,C} = \left[\frac{12}{N(N+1)} \sum_{i=1}^c \left(\frac{R_i^2}{n_i} \right) \right] - 3(N+1) \sim \chi_{c-1}^2 \quad (3)$$

2.4. Regression with ARIMA Errors

The regression with ARIMA errors is simply an ARIMA model with additional or input variables. The model is an integration of a regression model with an ARIMA model. The result of this model covers the advantages of both models. The regression method describes the explanatory relationship while the ARIMA method takes care of the autocorrelation in the residuals of the regression model. The model is given by;

$$Y_t = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k + \frac{\theta(L)\theta(L^s)}{\phi(L)\Phi(L^s)(1-L)^d(1-L^s)^p} \varepsilon_t \quad (4)$$

where X_i represents the additional variable.

3. Results and Discussion

The maximum and minimum number of total births in the metropolis within the period are 1413 and 94, whilst that of stillbirths are 47 and 0 respectively as shown in Table 1. Also, total number of births and stillbirth in the metropolis was positively skewed and platokurtic in nature with their averages been 580 and 13.92 respectively. There was a great variation in the total number of stillbirth recorded over the period since it had the highest coefficient of variability.

The number of macerated stillbirth and fresh stillbirth were both positively skewed and leptokurtic in nature. They however have averages of 8.735 and 5.185 respectively.

An exploration of the total number of births and total

number of stillbirths according to months recorded in the metropolis within the period revealed that the highest average number of total births and still births were recorded in the months of October and November respectively as shown in tables 2 and 3.

The maximum number of total births and stillbirths were both recorded in the month of February. Comparism of the coefficient of variation of the months showed that there was great variability in total number of births and stillbirths in the months of March and August since they have the highest coefficients of variation as compared to the other months. It was also observed that total births and stillbirth were positively skewed for all months.

Table 1. Descriptive Statistics of total births, total stillbirths, macerated and fresh still births

Variable	Count	Mean	CoefVar	Min.	Max.	Skewness	Kurtosis
total births	162	580.0	57.80	94.0	1413.0	0.35	-0.82
totalstillbirths	162	13.92	101.99	0.00	47.00	0.81	-0.93
macerated	162	8.735	125.71	0.000	39.000	1.30	0.40
fresh	162	5.185	132.19	0.000	36.000	2.19	4.71

Table 2. Descriptive Statistics of total births by months

mth	Count	Mean	CoefVar	Minimum	Maximum	Skewness	Kurtosis
Jan	15	529.7	58.06	131.0	1086.0	0.24	-0.98
Feb	15	511.2	60.75	94.0	1057.0	0.26	-0.91
Mar	15	556.3	62.41	120.0	1318.0	0.62	0.07
Apr	15	586.7	58.15	160.0	1236.0	0.45	-0.71
May	15	627.5	57.23	153.0	1236.0	0.33	-1.05
Jun	15	578.5	59.16	118.0	1176.0	0.41	-0.70
Jul	12	529.2	58.35	130.0	1044.0	0.13	-1.18
Aug	12	540.9	61.38	131.0	1195.0	0.41	-0.42
Sep	12	584.8	57.71	145.0	1087.0	0.15	-1.27
Oct	12	684.0	58.67	193.0	1413.0	0.49	-0.73
Nov	12	659.0	58.58	149.0	1259.0	0.07	-1.30
Dec	12	595.0	58.37	138.0	1169.0	0.10	-1.10

Table 3. Descriptive Statistics of total number of stillbirths by months

mth	Count	Mean	CoefVar	Minimum	Maximum	Skewness	Kurtosis
Jan	15	13.87	92.07	2.00	39.00	0.80	-0.89
Feb	15	10.67	112.98	0.00	33.00	0.90	-1.02
Mar	15	15.73	109.84	0.00	43.00	0.76	-1.43
Apr	15	13.53	108.02	1.00	44.00	0.94	-0.67
May	15	15.33	97.82	2.00	39.00	0.72	-1.48
Jun	15	12.60	106.39	0.00	37.00	0.79	-1.20
Jul	12	11.42	104.81	0.00	30.00	0.67	-1.41
Aug	12	13.83	115.20	0.00	42.00	1.03	-0.65
Sep	12	13.33	110.20	0.00	41.00	0.91	-0.73
Oct	12	16.08	102.76	0.00	47.00	0.88	-0.80
Nov	12	16.58	95.01	2.00	41.00	0.76	-1.50
Dec	12	14.50	100.26	0.00	39.00	0.80	-1.05

Table 4. Descriptive Statistics of macerated stillbirths by months

Mth	Count	Mean	CoefVar	Min	Max.	Skewness	Kurtosis
Jan	15	7.27	117.06	0.00	28.00	1.64	1.98
Feb	15	5.73	135.82	0.00	21.00	1.34	0.20
Mar	15	9.87	145.31	0.00	39.00	1.58	0.85
Apr	15	8.00	128.09	1.00	32.00	1.44	0.77
May	15	10.73	117.45	0.00	38.00	1.08	-0.15
Jun	15	8.40	129.54	0.00	30.00	1.14	-0.31
Jul	12	7.42	114.33	0.00	22.00	0.77	-1.15
Aug	12	9.50	121.73	0.00	29.00	0.91	-1.12
Sep	12	9.75	140.57	0.00	37.00	1.29	0.14
Oct	12	8.25	124.06	0.00	28.00	1.38	0.59
Nov	12	12.00	117.64	0.00	35.00	0.86	-1.32
Dec	12	8.50	123.85	0.00	36.00	1.85	3.67

Table 5. Descriptive Statistics of fresh stillbirths by months

Mth	Count	Mean	CoefVar	Min.	Max.	Skewness	Kurtosis
Jan	15	6.60	122.13	0.00	26.00	1.62	1.70
Feb	15	4.93	143.63	0.00	21.00	1.62	1.27
Mar	15	5.87	164.62	0.00	33.00	2.38	4.84
Apr	15	5.53	134.18	0.00	22.00	1.58	1.31
May	15	4.60	110.79	0.00	17.00	1.69	2.20
Jun	15	4.20	106.93	0.00	14.00	1.16	0.02
Jul	12	4.00	129.25	0.00	16.00	1.75	2.18
Aug	12	4.33	135.75	0.00	19.00	2.05	3.31
Sep	12	3.58	101.29	0.00	14.00	2.32	7.00
Oct	12	7.83	141.72	0.00	36.00	2.05	3.52
Nov	12	4.58	87.99	0.00	16.00	2.26	6.43
Dec	12	6.00	129.29	0.00	24.00	1.85	2.36

Investigation of the distribution of macerated and fresh stillbirths according to months recorded in the metropolis within the period revealed that the highest average number macerated and fresh stillbirths were recorded in the months of November and October respectively as shown in Tables 4 and 5.

There was great variability in the number of macerated and fresh stillbirths recorded in the month of March as is characterized by the high coefficient of variation recorded in comparison with the other months. Also, both the number of macerated and fresh stillbirths recorded were positively skewed.

The Mann-Whitney test revealed that there are significant differences in the number of macerated and fresh stillbirths recorded over the period as shown in Table 6.

Table 6. Mann-Whitney Test of Macerated and Fresh stillbirths

Variable	N	Median	W	p-value
macerated	162	3	27656	0.1145
fresh	162	3		

Table 7 summarizes the distributions of stillbirth rate in the Tamale metropolis (from January 2009 to June 2013). The stillbirth rate from 2009 to 2011 ranged between 25.01 per 1000 births and 25.52 per 1000 births. These rates were higher than the world wide rate of 18.9 per 1000births, much lower than the rate for developed countries (3 per 1000 births) and lower than the rate for sub-Saharan Africa (28 per 1000 births) [1, 3]. There was however a decline in these rates for 2012 (22.86 per 1000 births) and 2013 (21.91 per 1000 births) respectively.

Table 7. Distributions of stillbirth rate in the tamale metropolis

year	stillbirth	total births	stillbirth rate
2009	441	17630	25.01
2010	484	19046	25.41
2011	522	20457	25.52
2012	557	24369	22.86
2013	273	12460	21.91

Table 8. Distributions of stillbirth rate in the Tamale Metropolis by hospitals

year	Tamale West hospital			Tamale Central hospital			Tamale Teaching hospital		
	stillbirth	total births	stillbirth rate	stillbirth	total births	stillbirth rate	stillbirth	total births	stillbirth rate
2009	54	1776	30.41	25	9660	2.59	362	6194	58.44
2010	55	1730	31.79	16	10521	1.52	413	6795	60.78
2011	79	2262	34.92	41	11442	3.58	402	6753	59.53
2012	119	3341	35.62	25	13664	1.83	413	7364	56.08
2013	54	2024	26.68	18	6986	2.58	201	3450	58.26

There is however a difference in these rates for the various hospitals in the metropolis over the period (January 2009 to June 2013) as shown in Table 8.

Tamale West Hospital recorded stillbirth rates ranging between 26.68 and 35.62 per 1000 births with the lowest and highest rates been recorded in 2013 and 2012 respectively. Tamale Central Hospital recorded the lowest of the stillbirth rates within the metropolis with rates ranging between 1.52 and 3.58 per 1000 births with the highest and lowest rates been recorded in 2010 and 2011 respectively, whilst Tamale Teaching Hospital recorded the highest of the stillbirth rates with rates ranging between 56.08 and 60.78 per 1000 births with the lowest and highest rates been recorded in 2012 and 2010 respectively. The rates for the Tamale West and Teaching Hospitals were respectively higher than both the world wide and sub-Saharan Africa's rate, whilst those for the Tamale Central Hospital were less than that for even the developed countries [1, 3].

A test to determine if the total number of stillbirths recorded varied significantly from hospital to hospital was carried out using Kruskal Wallis test. The test revealed there were significant differences in the total number of stillbirths recorded at the various hospitals as shown in Table 9.

Table 9. Kruskal-Wallis Test on total number of stillbirths

hospital	N	median	average rank	Z
central	54	2	34.4	-9.05
teaching	54	32	135.5	10.36
west	54	6	74.6	-1.31
total	162		81.5	
H=127.26	DF=2	P=0.000		
H=127.85	DF=2	P=0.000	(adjusted for ties)	

The total number of still births was regressed on the full set of periodic dummies to check the effect of each month. The intercept was not included in the model to avoid dummy variable trap, however the regression was poor since it had F-statistic and a p-value of 0.059787 and 0.059787 respectively, indicating the overall regression model was not significant at 5%. Also the low R-square value (0.337996) is an indication of a poor fit. Furthermore a Ljung-Box Q' of

43.1234 and a p-value of 2.15×10^{-5} at lag 12 is an indication of serial correlation in the residuals of the model. A new regression was fitted with an ARMA(1,1) residual to capture the problem of serial correlation. Table 10 shows that the parameters of the ARMA(1,1) and the periodic dummies were all significant.

Table 10. Regression with ARMA (1, 1) errors

Parameter	Coefficient	Std. Error	Z	p-value
AR(1)	0.955091	0.0518776	18.4105	0.00001
MA(1)	-0.813192	0.0872745	-9.3176	0.00001
Jan	41.7891	3.90797	10.6933	0.00001
Feb	32.102	3.90889	8.2126	0.00001
Mar	47.2152	3.9092	12.078	0.00001
Apr	40.5285	3.90894	10.3681	0.00001
May	45.8415	3.90812	11.7298	0.00001
Jun	37.5543	3.90668	9.6128	0.00001
Jul	34.5614	4.21139	8.2066	0.00001
Aug	41.668	4.21623	9.8828	0.00001
Sep	40.0251	4.2185	9.488	0.00001
Oct	48.1322	4.21823	11.4105	0.00001
Nov	49.489	4.2154	11.7401	0.00001
Dec	43.0954	4.21001	10.2364	0.00001

Also the coefficients of the periodic dummies were all positive indicating a unit change in the periodic dummies increases the total number of stillbirths with time. For instance, a unit change in November increases the total number of stillbirths by 49.489.

4. Conclusions

The study sought to determine the stillbirth rate in the Tamale metropolis and to investigate whether or not these rates significantly varied according to types and hospitals using Secondary data on still birth for the Tamale metropolis obtained from the Ghana health service District Health Information Management (DHIMS) from January, 2009 to June, 2013.

The average monthly total number of births and stillbirth in the metropolis over the period were 580 and 13.92 respectively whilst the average number macerated stillbirth and of fresh stillbirth were 8.735 and 5.185 respectively. On

the average, the highest number of births and still births were recorded in October and November respectively.

Investigation of the descriptive statistics of macerated and fresh stillbirths according to months recorded in the metropolis within the period revealed that the highest average numbers of macerated and fresh stillbirths were recorded in the months of November and October respectively. Also there were no significant differences in the number of macerated and fresh stillbirths recorded over the period.

The stillbirth rate for the metropolis from 2009 to 2011 ranged between 25.01 per 1000 births and 25.52 per 1000 births. There was however a decline in these rates for 2012 (22.86 per 1000 births) and 2013 (21.91 per 1000 births) respectively. There were however significant differences in the total number of stillbirths recorded at the various hospitals in the metropolis over the period, Tamale west hospital recorded stillbirth rates ranging between 26.68 and 35.62 per 1000 births, Tamale central hospital recorded the lowest of the stillbirth rates ranging between 1.52 and 3.58 per 1000 births, whilst Tamale teaching hospital recorded the highest of the stillbirth rates with rates ranging between 56.08 and 60.78 per 1000 births.

A regression model fitted with an ARMA (1, 1) residual revealed that a unit change in the periodic dummies increases the total number of stillbirths with time.

Though stillbirth rates for the period in the metropolis were lower than that for sub-Saharan Africa, extensive education on stillbirth is still needed if the metropolis is to make progress in achieving the MDGs 4 and 5 or is to aspire a feat on stillbirth rate close to that of the developed countries.

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