ACTUARIAL ANALYSIS OF INFANTS' CRUDE DEATH AND SURVIVAL TRENDS IN JOS METROPOLIS, NIGERIA

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ABSTRACT

The prime reason for this study is to predict if there is a drastic improvement in child birth survival by predicting which of the months and quarters are safer to give birth and to examine the effect of seasonal variation on chances of infants' survival for the period of 8 years. The specific goal of the study is to investigate if both male and female survival rates have any significant influence on infants live births exposed to risk. Mathematical methods were developed and used to determine crude death rate and survival rate. The Least Square method was used to analyse the data computed. Using specific gender exposed to risk for all quarters, the first quarter shows that male is more exposed to risk of death than female. These rates obtained through mathematical methods provide safe margin for statistical estimation and predictions to establish which months and quarter of the year are safer for infants' survival in Jos. The combine mortality for male and female is somewhat constant for the first to third quarters except that in the fourth quarter which is slightly higher than other quarters. As one moves from the first to higher quarters, the chances of child survival decreases. Application of methodical methods developed in this study provides new approach to how crude death rate and survival rate can be determined.

Keywords**:** *crude death rate, infant mortality, crude survival*

1.0 INTRODUCTION

Infant mortality rate (IMR) is one of the most sensitive indicators of country' wellbeing, in relation to different factors, such as maternal health, quality and access to medical services, socioeconomic condition and public health policies (Barría-Pailaquilén *et al*, 2011). In a bid to reducing child mortality, massive investment has been committed to improve access to health-care, nutrition, hygiene and sanitation, and promote exclusive breastfeeding (Lawn *et al*, 2005; Claeson *et al*, 2000).

Over the last twenty years, infant and child survival has remained a top global priority (Dube, Taha and Asefa, 2013; Reidpath and Allotey, 2003). During the period of high mortality, many risk factors responsible for infant mortality incidence have been identified including low maternal education, low maternal age, and short birth spacing (Mturi and Curtis, 1995; Whitworth and Stephenson, 2002; Sartorius, Kahn, Vounatsou, Collinson and Tollman, 2010). Byberg *et al* (2005) noted that it is not well known whether these risk factors are still important with declining mortality. Out of 130 infant deaths that occur around the world every year, more than four million happen within the first four weeks after births. Three quarters of these deaths occur in the first week, and the first day of life represents the highest risk (Cousens and Zupan, 2005; Zupan and Perinatal, 2005)

The risk of dying varies with a number of factors – sex and age, and other factors which influence the physical constitution or the environment of the people, such as birthplace, geographical locality of residence, occupation, and marital condition. In calculating rates of mortality it is therefore necessary to differentiate the influence of these factors as well as to distinguish the contribution of different medical causes of death (type of disease or injury). Death rates may therefore be classified as general or specific, the first relating to all causes of death and to the general population, the second to special causes of death or to deaths in particular sections of the population, or both (Benjamin, and Pollard, 1980). Conversely the deaths must comprise all those occurring in this population and no others. The denominator of the rate (of which the numerator is the relevant number of deaths) is commonly referred to as 'the population at risk'.

The purpose of measuring mortality is to enable statistical inferences to be drawn about the likelihood of death occurring within a specific population during a specific period of time. It is natural, therefore, for the basic measure to be expressed in proportional terms as a rate of mortality – the number of deaths occurring per unit of population in a particular interval of time. The unit of population may commonly be 1,000, 10,000, 100,000 or a million: it is a matter of arithmetical convenience (Benjamin, and Pollard, 1980).

In this study, we attempt to predict whether there has been improvement in childbirth over a period of 10 years by predicting which month of the year is most significantly safer for child bearing. The study also attempts to determine whether male birth rates and female birth rates have significant influence on infants live births exposed to risks of infants from 2008-2017.

From the foregoing, the specific objectives of the study are to investigate if male and female survival rates have any significant influence on infants live births exposed to risks; and to determine the effect of male and female survival rates on infants' death rates. The corresponding hypotheses include: Ho1: Male and female survival rates have significant influence on infants live births exposed to risks; Ho2: Male and female survival rates have no significant impact on infants' death rates.

2.0 MATERIALS AND METHODS

2.1 Materials

Globally, child mortality has declined particularly among older children and in the most developed regions of the world (UNICEF, 2014). However, in Sub-Saharan Africa, compared to other region of the world, under-five mortality is yet to decline as Sub-Saharan Africa still dominate exactly half of all child deaths worldwide in 2011 (UNICEF, 2012). Even though, the Bandim Health Project (BHP) documented that Guinea-Bissau in West Africa experience a drop of infant mortality rate from 192 per 1000 in the early 1990's, to 135 per 1000 in the 2003–5 (Byberg *et al.,* 2005), the country still recorded the seventh highest infant mortality rate in the world (UNICEF, 2012) even though is a very small country.

In the combined dataset of the two birth cohorts investigated by Byberg *et al.* (2005) and Ogunlesi and Olanrewaju (2010) on whether the risk factors had changed over time in the two cohorts it was found that higher level of maternal education is associated with a more active health seeking behaviour for childhood illness. As the level of education is generally low in Guinea-Bissau and the health centres where mothers would seek care, often lack essential drugs and other necessities, the influence of maternal education may be limited in this setting, could neither find any association with maternal education or a consistent effect of distance to the health centre. They also found that living close to a hospital (<10 km) was associated with lower risk of infant mortality in 2002–3 –a change from 1992–3 where distance to hospital was not associated with infant mortality.

To date, different child mortality studies have been published with a focus on distinct viewpoints (clinical, epidemiological, demographic, etc.), aiming to explain trends, causes and relations with specific factor and assessing the behaviors of its several components (Barría-Pailaquilén *et al*, 2011). Banerjee (2018) noted that physiological and behavioural factors together with maternal and demographic factors are perhaps more important than the health programmes for reduction of infant mortality. Byberg *et al.* (2018) studied these risk factors: sex of the child, region, maternal ethnicity and education, season of birth (rainy season (June-November) vs. dry season (December-May), maternal age at birth of the child, previous loss of child, if the child was delivered with skilled attendance, born at a health care facility, distance to nearest health facility, number of siblings and twin status.

For many years, it has been observed that many pregnant women do not have access to good healthcare delivery particularly those in the rural areas. In the process of childbirth, many women have lost their lives and babies due to inability to access quality healthcare. In hospitals where there is no quality facility, the chance of successful childbirth delivery is very low while the reverse is expected to lead to increased infant survival. Apart from hospitals processing quality healthcare facilities, there is also need to have both qualified Doctors, pharmacists, and nurses in place to be able to give the desired health outcome. Hence, for a period of say 10 to 15 years, if the infant mortality is dropping, it can be said that such hospital in term of personnel and facilities is adequate.

In a longitudinal survey conducted by Weldearegawi *et al* (2015), their finding of higher risks of death in infants born to teenage mothers is consistent with the existing literature (Kusneniwar *et al.,* 2013; Monadal *et al*, 2009; Finlay *et al*, 2011; Freemantle *et al*., 2009; Hobcraft, 1993; Govindasamy and Ramesh, 1997; Singh and Tripathi, 2013; Lisonkova, Pare and Joseph, 2013). Several studies have shown that infants born to mothers of under 19 years old have higher risk of death than infants born to mothers in the age group of 20–29 years (Kusneniwar *et al,* 2013; Monadal *et al.,* 2009; Finlay *et al*, 2011).

Unfavourable outcome of infants born to teenage mothers has been associated with increased risk of low birth weight and associated complications (Kusneniwar *et al.,* 2013; Monadal *et al*, 2009; Pare and Joseph, 2013). In view of these figures, caution need to be exercised in their interpretations. For example, young women whose infants have high rates of mortality are, in addition to their relative youth, also more likely to be unmarried and to be of lower socioeconomic status with a higher prevalence of associated risk factors for infant mortality (Kurinczuk *et al*., 2009). From the data presented here it is not possible to disentangle which of these factors is responsible for the higher risk of infant mortality and which are confounders.

2.2 METHOD OF DATA ANALYSIS

2.2.1 Mathematical model for crude death and survival rates

In infancy and early childhood, boys are generally more vulnerable to some birth hazards prematurity, malformation, birth injury and infection, possibly as a result of some biological factor, and to injuries, possibly as a more vigorous and venturesome activity; these are the principal causes of death at these ages. Crude death rate is a weighted average of age-specific rates in which the weights are the numbers of the population in the respective age groups. If 1/2) tP(x,+is the mid-year population and t)D(x,is the death counts, then t)m(x, is the death rate at age x to tx+ while t)E(x,is the central exposed to risk. Also, if t)(x,E_c is the population in the same age group, the total deaths will be $\sum_x E^c(x,t) \times m(x,t)$ where the summation is over all age groups, and the total population $\sum_x E^c(x,t)$ so that the

$$\textit{Crude death rate} = \frac{\sum_x E^c(x,t) \times m(x,t)}{\sum_x E^c(x,t)} \quad \text{... (1)}$$

Child survival at birth is very uncertain as the force of mortality varies during this time interval. The increasing maternal and infant mortality in the country can be ascribed to poor healthcare delivery while a steady decline in infant mortality can be used as proxy for good healthcare delivery (Benjamin, & Pollard, 1980).

Similarly, D(x, = t) death counts
P(x, t) = number of persons age x last birthday of exact time t which is calculated once rather than continuously.

The mid-year population can be estimated by | $P\left(x,t+\frac{1}{2}\right)$ so that

$$m(x,t) = \frac{D(x,t)}{P\left(x,t+\frac{1}{2}\right)} = \frac{D(x,t)}{E(x,t)} \quad \ldots (2)$$

However, death central exposed to risk is given as:

$$m(x,t) = \frac{D(x,t)}{E(x,t)} \quad \ldots (3)$$

Where $E(x,t) \approx P\left(x,t+\frac{1}{2}\right)$

if $E(x,t)$ is the central exposed to risk.

Using trapezoidal rule of integration with stepsize h =1, Wilmonth et al (2007) estimate death central exposed to be:

$$\begin{aligned} E(x,t) &= \int_0^1 P(x,s+t)ds \\ &= \frac{P(x,t)+P(x,t+1)}{2} \end{aligned} \quad \ldots (4)$$

$$\sum_x D(x,t) = \text{total number of deaths}$$

If the population is estimated on the first day of each year

Then $E(x,t) = \dfrac{2D(x,t+1)}{P(x,t)+P(x,t+1)}$ … (5)

Where $P\left(x,t+\frac{1}{2}\right)$ = population estimation of the middle of each year

We define $P(x,t+0)$ = population estimates of the beginning of each year and

$P(x,t+1)$ = population estimates at the end of each year.

Crude survival rate is a weighted average of age-specific rates in which the weights are the numbers of the population in the respective age groups, i.e. if $n(x,t)$ is the survival rate within the age interval x to x+t, and $E^c(n,t)$ is the population in the same age group, the total deaths will be $\sum E^c(x,t) \times n(x,t)$ where the summation is over all age groups, and the total population $\sum, E^c(x,t)$, so that the

$$\text{Crude survival rate} = \frac{\sum_x E^c(x,t) \times m(x,t)}{\sum_x E^c(x,t)} \quad \ldots (6)$$

2.2.2 Statistical models

Specific gender survival rate and general survival rate- To determine how specific gender affects the infant mortality rate, the following models were developed for purpose of predicting which gender has higher change of survival between male and female.

Hence,

$$CSR = f(MSR, FSR) \quad \ldots (7a)$$

$$CSR = \beta_0 + \beta_1 MSR + \beta_2 FSR + \varepsilon \quad \ldots (7b)$$

where

CSR = Crude survival rate

MSF = Male survival rate

FSR = Female survival rate

and ε = *error term*

β_0 is the intercept; β_1 to β_2 represent coefficient of the variables measured

Specific gender survival rate and general death rate- These models are the inverse of models (7a) and (7b) which are designed to determine the impact of infant survival on their crude death rates.

$$CDR = f(MSR, FSR) \quad \ldots (8a)$$

$$CDR = \beta_0 + \beta_1 MSR + \beta_2 FSR + \varepsilon \quad \ldots (8b)$$

where

CDR = Crude survival rate

MSF = Male survival rate

FSR = Female survival rate

and ε = *error term*

β_0 is the intercept; β_1 to β_2 represent coefficient of the variables measured

2.2.3 *Data source and method*

This study adopted secondary data which were obtained through an administrative procedure from the statistics/medical records department of Jos University Teaching Hospital. Permission from the Department was sought in which access

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ISSN: 2016-1303 | Web: www.cjpas.fulokoja.edu.ng

to records were granted. Data in respect of death and survival for male and female infants covering a period of 10 years (2008-2017) were extracted from medical records office of the hospital. Details of figures extracted are contained in Tables 1a and 1b. The corresponding curves for these data were also shown in Figures 1 and 2 showing the infants' live births and deaths patterns.

Descriptive statistics, regression, and correlation statistics were used to analyse the data collected. The choice of JUTH over other hospitals in Jos Metropolis is due to capital intensive project executed to meet the yearning needs of the residents of Plateau State, Nigeria which were executed during the former President Olusegun Obasanjo following the bomb blast of old JUTH in Terminus. The hospital hosts a seasoned scholars in the field of medicine and is well entrenched with adequate facilities which cannot be found in other hospitals in the metropolis. However, this study does not cover childbirths outside the hospitals because many do not have access to hospitals facilities.

Table 1a: Male specific crude death rate and survival rate

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total mortality
2008	90	80	50	30	70	85	80	55	65	55	70	44	16
2009	65	80	70	67	58	40	62	70	80	60	40	67	14
2010	63	59	91	78	65	85	90	88	65	72	90	90	15
2011	82	40	70	80	69	59	54	81	41	70	56	69	15
2012	32	90	81	60	90	82	81	67	35	79	85	51	15
2013	70	39	42	54	72	33	53	89	91	59	90	76	12
2014	45	44	85	61	63	43	71	84	99	28	51	43	11
2015	57	63	81	54	52	54	82	77	35	80	68	71	8
2016	62	44	80	71	51	80	65	72	86	76	60	48	7
2017	50	54	33	45	89	78	66	91	69	90	66	80	4
Total	616	593	683	600	679	639	704	774	666	669	676	639	117

Source: Authors' computation.

Table 1b male infants mortality

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
2008	2	2	2	1	2	1	2	0	0	1	2	1	16
2009	0	1	1	2	0	2	2	2	1	2	0	1	14
2010	2	1	0	1	2	2	0	2	2	1	0	2	15
2011	1	2	1	1	2	3	1	0	1	0	1	2	15
2012	0	2	2	0	1	0	2	2	1	1	2	2	15
2013	0	2	2	2	1	0	0	0	1	1	2	1	12
2014	1	1	1	1	0	1	2	0	1	1	1	1	11
2015	0	0	2	1	1	0	0	2	0	0	1	1	8
2016	1	1	1	0	0	1	2	0	1	0	0	0	7
2017	0	1	0	0	1	0	1	0	1	0	0	0	4
Total	7	13	12	9	10	10	12	8	9	7	9	11	117

Source: Authors' computation.

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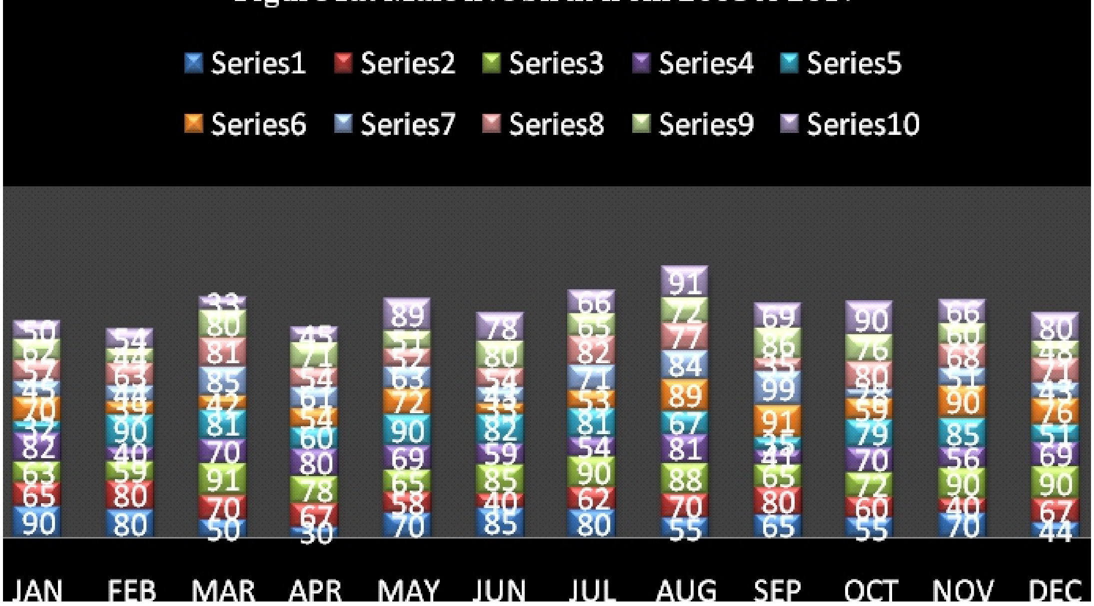

Figure 1a: Male live birth from 2008 to 2017

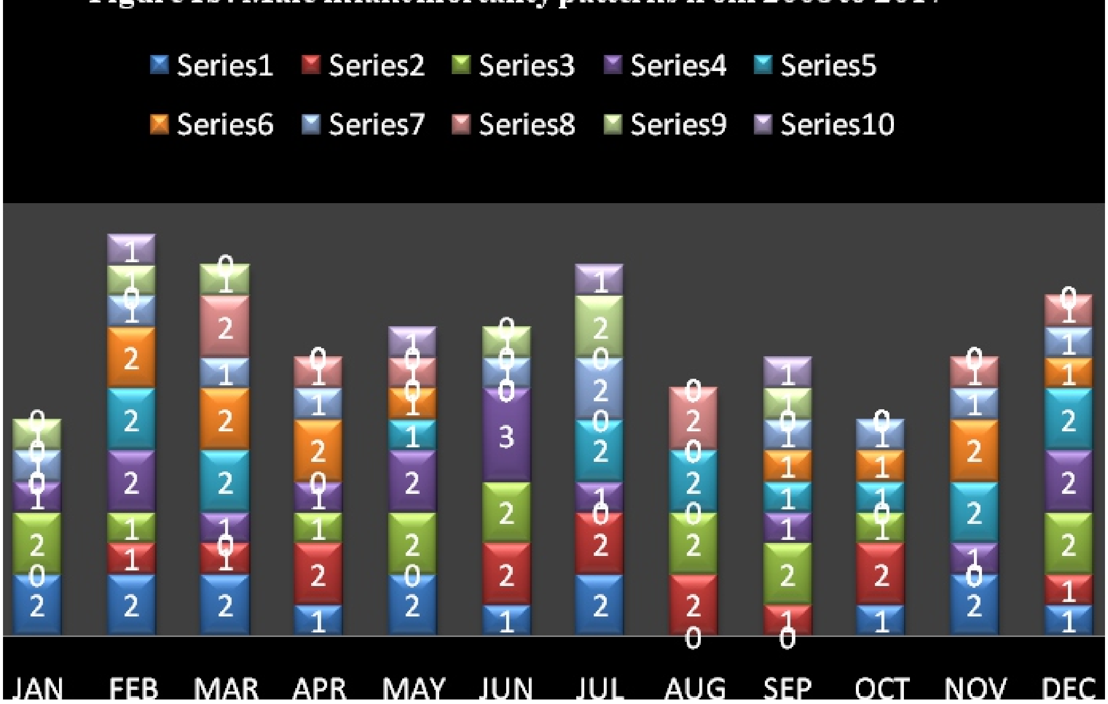

Figure 1b: Male infant mortality patterns from 2008 to 2017

3.0 RESULTS AND DISCUSSION

3.1. Infants' mortality and survival patterns: This section deals with presentation of data in respect of infants' mortality and corresponding survival rates in Jos metropolis. The data are presented in months for male and female specific crude death rates and survival rates with the hope of determining the months that produces higher infants mortality or reduces infants mortality for the years under investigation. Also, the infants mortality rates are presented yearly to ascertain whether there has been improvement in healthcare delivery the selected hospital.

The causes of deaths are indirect including long labour, complications and other parental factors that have to deal with family history and education background. All of these factors are indirect causes of infants' mortality in JUTH.

Table 2: Monthly specific crude death rate between male and female for 10 years (2008-2017)

	Male		Female		Crude death rate	
Month	Exposed to risk	Death	Exposed to risk	Death	Male	Female
JAN	616	7	590	11	0.011364	0.018644
FEB	593	13	638	8	0.021922	0.012539
MAR	683	12	577	8	0.01757	0.013865
APR	600	9	558	9	0.015	0.016129
MAY	679	10	489	9	0.014728	0.018405
JUN	639	10	658	13	0.015649	0.019757
JUL	704	12	514	11	0.017045	0.021401
AUG	774	8	639	16	0.010336	0.025039
SEP	666	9	645	7	0.013514	0.010853
OCT	669	7	624	13	0.010463	0.020833
NOV	676	9	566	8	0.013314	0.014134
DEC	639	11	666	113	0.017214	0.16967
Total	7938	117	7164	226	0.014739	0.031547

Source: Authors' computation

For the period of 10 years under investigation, the crude death rate of male and female in the month of January are 0.011364 and 0.018644 respectively which means that male death rate is less than that of female. However, the male death rate (0.021922) is higher than that of female (0.012539) in the month of February for all years. Also, in the month of March and September, the male mortality rates are 0.017570 and 0.013514 are higher than that of female in the same months of March (0.013865) and September (0.010853) respectively. For other months like April (0.015000), May (0.014728), July (0.015649) and August (0.010336), the male mortality rates are lesser than that of female. In all of the 10 years, the lowest mortality for male takes place in the month of August (0.010336) and is lower than that of female that of female takes place in the month of September (0.010853). Similarly, the highest mortality rate for male mortality took place in the month of February (0.021922) while that of female which is far higher than that of male happened in December (0.169670). With these comparisons, it is uncertain to determine which of the male and female has lower mortality than the other without specific reference to the total crude death rate for all years. As it can be seen in the table, it is clear that male has lower mortality rate than that of female counterpart.

Table 3: Infants month specific survival rates in JUTH for 10 years (2008-2017)

	Male		Female		Crude survival rate	
Month	Exposed to risk	Lives	Exposed to risk	Lives	Male	Female
JAN	616	609	590	579	0.988636	0.981356
FEB	593	580	638	630	0.978078	0.987461
MAR	683	671	577	569	0.98243	0.986135
APR	600	591	558	549	0.985	0.983871
MAY	679	669	489	480	0.985272	0.981595
JUN	639	629	658	645	0.984351	0.980243
JUL	704	692	514	503	0.982955	0.978599
AUG	774	766	639	623	0.989664	0.974961
SEP	666	657	645	638	0.986486	0.989147
OCT	669	662	624	611	0.989537	0.979167
NOV	676	667	566	558	0.986686	0.985866
DEC	639	628	666	553	0.982786	0.83033
Total	7938	7821	7164	6938	0.985261	0.968453

Source: Authors' computation.

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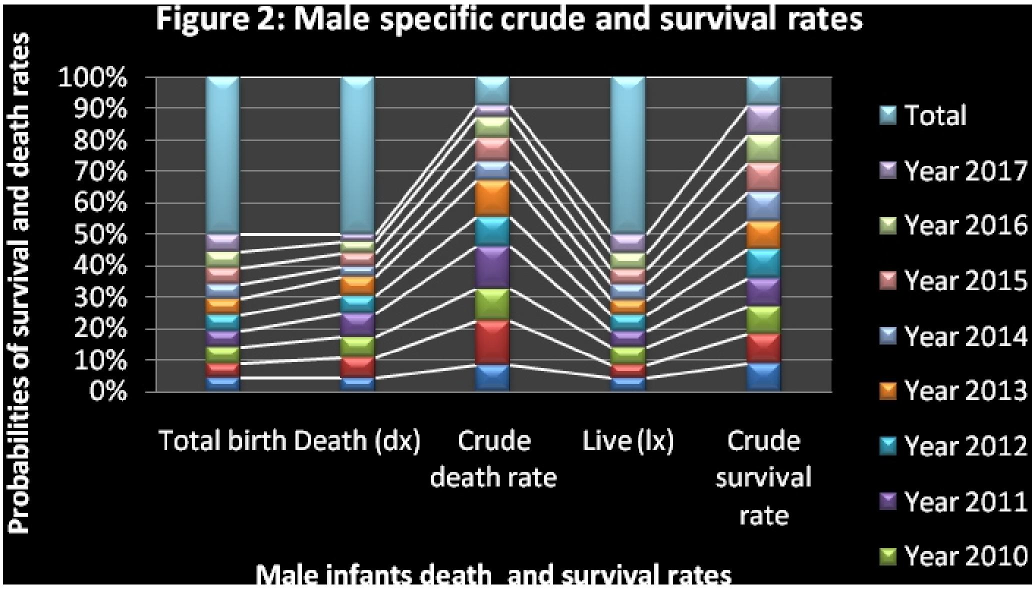
ISSN: 2016-1303 | ***Web:*** *www.cjpas.fulokoja.edu.ng*

Using the same method of interpretation employed in Table1 for the period of 10 years under investigation, the crude survival rate of male in the month of January is 0.988636 which is slightly higher than that of female (0.981356). The male survival rates for the months of April to August as well as October to December are higher than that of female counterpart for those months but slightly lower than that of female in the months of September. The highest survival rate for male took place for the month of August (0.989664) while that of female took place in the month of September (0.989147). For all months and years total, the male survival rate (0.985261) is slightly higher than that of female (0.968453). From both tables, it can be inferred that male child has slightly higher chance of survival at birth than female. Also, it is clear that childbirth has higher chance of survival in the month of August while for female, it is September. These two months for male and female should be taken into consideration by policymakers when there is need to project into the future. The male crude death rates and survival rates are shown in Figure 2 while that of female crude death rates and survival rates are shown in Figures 3 respectively.



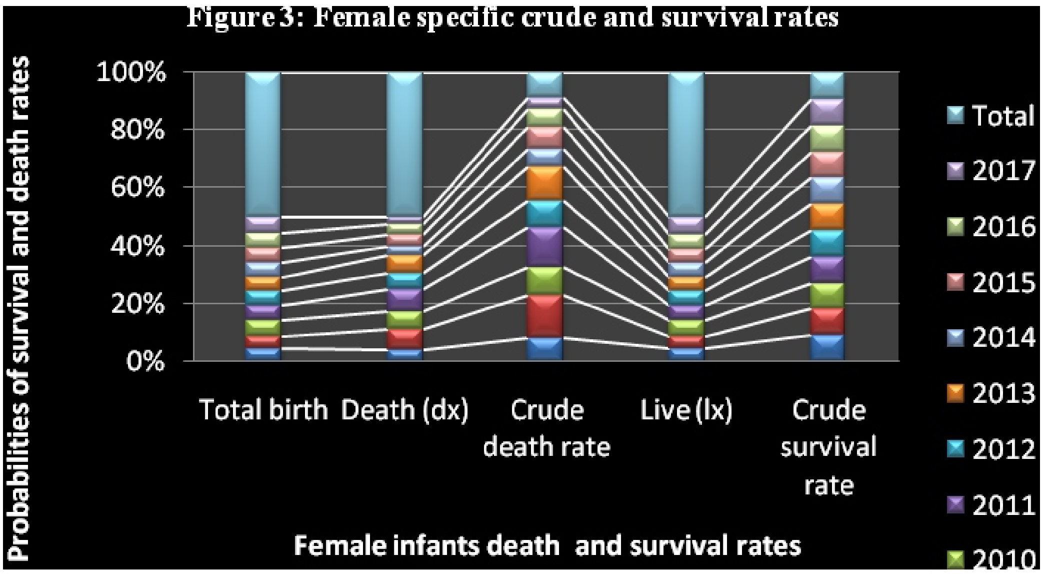


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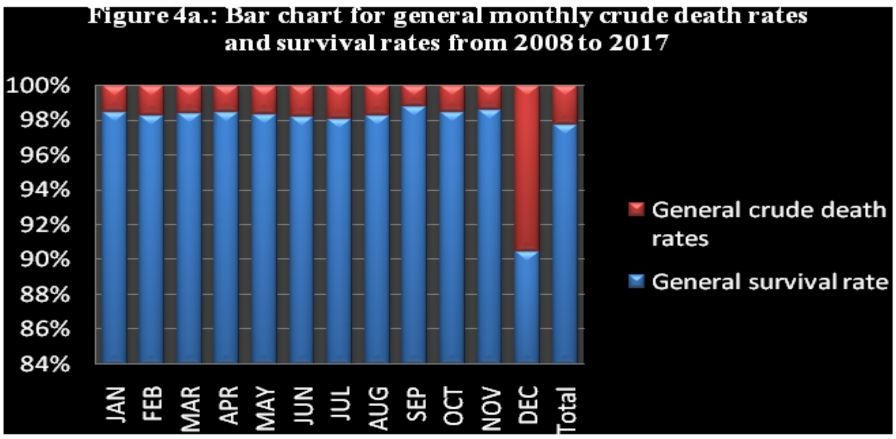
Table 4: General monthly crude death rates for 10 years (2008- 2017)

Month	Total exposed to risk	Total death	General crude death rate	Live	Survival rates
JAN	1206	18	0.014925	1188	0.985074627
FEB	1231	21	0.017059	1210	0.982940699
MAR	1260	20	0.015873	1240	0.984126984
APR	1158	18	0.015544	1140	0.984455959
MAY	1168	19	0.016267	1149	0.983732877
JUN	1297	23	0.017733	1274	0.982266769
JUL	1218	23	0.018883	1195	0.981116585
AUG	1413	24	0.016985	1389	0.983014862
SEP	1311	16	0.012204	1295	0.987795576
OCT	1293	20	0.015468	1273	0.984532096
NOV	1242	17	0.013688	1225	0.986312399
DEC	1305	124	0.095019	1181	0.904980843
Total	15102	343	0.022712	14759	0.977287776

Source: Authors' computation.

Table 4 shows the combined male and female infants monthly crude death rates and survival rates for 10 years (2008-2017). In the first and second months of the first and second quarters, the mortality rates are 14.93 per 1000 and 17.10 per 1000 respectively. In the first month of the third and fourth quarters corresponding mortality rates are 18.89 per 1000 and 15.47 per 1000. From the frequency it means for the first month of every quarter in every 1000 childbirths, close to 15, 17, 19 and 15 infants death are recorded respectively. Similarly, the survival rates for the first months of all quarters are 0.985074627, 0.984455959, 0.981116585 and 0.984532096 respectively. All these implied that for every 1000 births, at least 985, 984, 981, and 986 survived in the first months of all the quarters. Considering death rates and survival rates per 1000 for the entire table for all months, the highest mortality rate of 95 per 1000 took place in the month of December while the lowest mortality rate of 12 per 1000 took place in the month of September. Correspondingly, the highest survival rates of 988 per 1000 took place in the month of September while the lowest survival rate of 905 took place in the month of December. From this analysis, it is clear to say that high infants' mortality rates is to be expected in the month of December while the low mortality rate is to be expected in the month of September of every year. Invariably, the high survival rate for childbirths is to be expected in September while low survival usually occurs in the month of December. The summary of general survival rates and death rates is shown in Figure 3. The red colour indicates the death rate while the blue colour signifies the survival rates.



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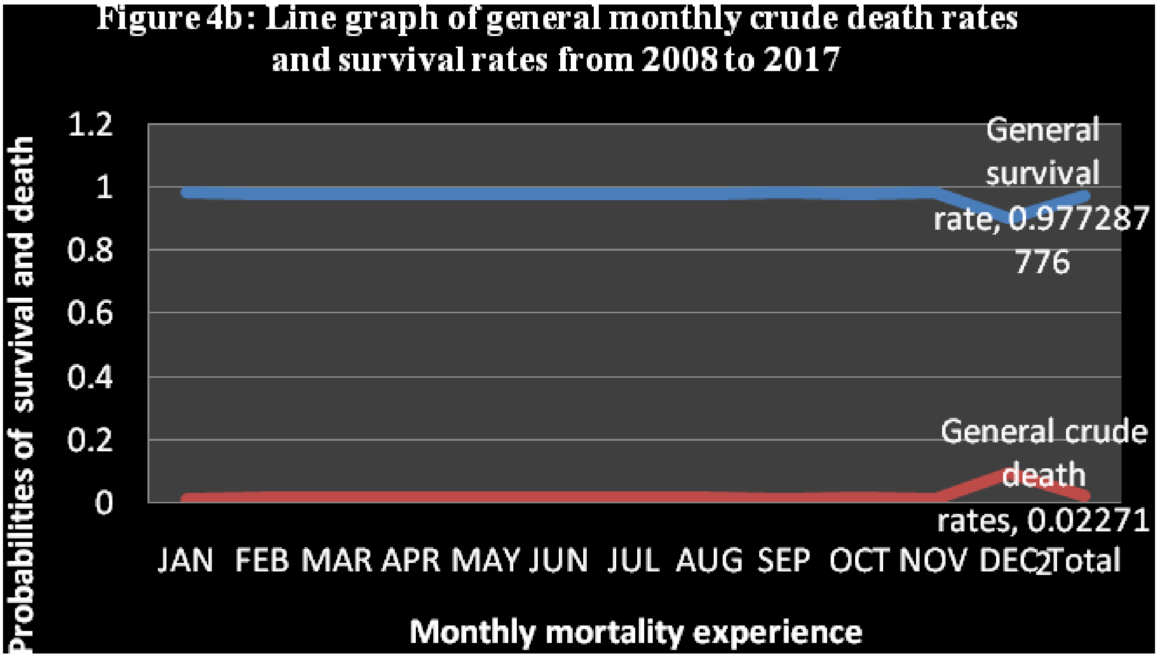
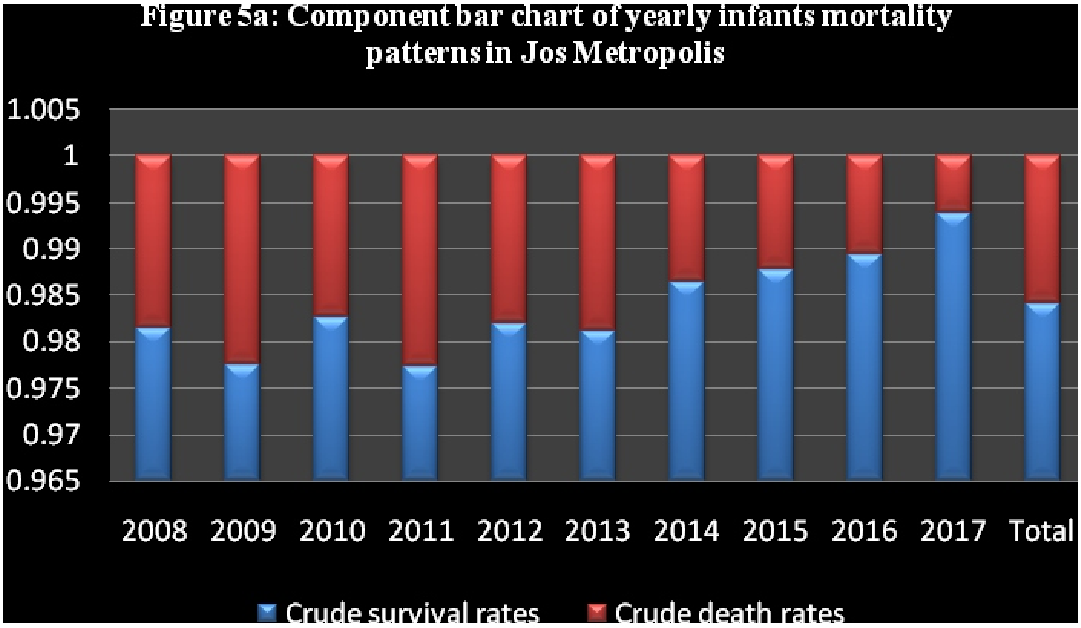


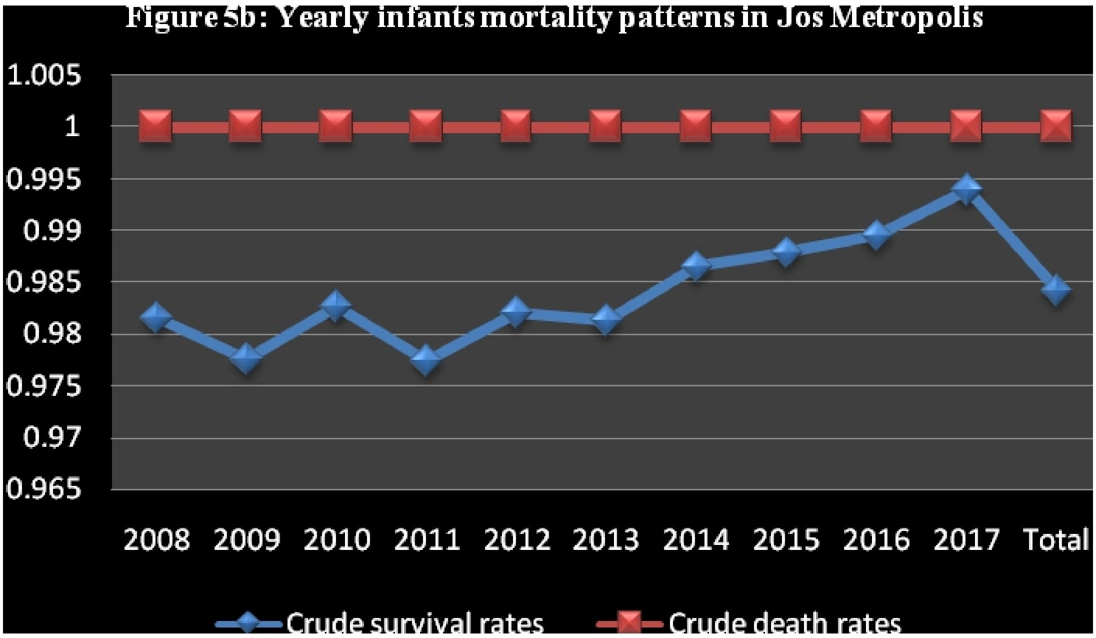
Table 5: Yearly general crude death rates and survival rates of infants for 10 years (2008-2017)

Year	Total exposed to risk	Number of death (d_x)	Crude death rates	Expected number of lives (l_x)	Crude survival rates
2008	1,409	26	0.018452803	1,383	0.981547197
2009	1,379	31	0.022480058	1,348	0.977519942
2010	1,734	30	0.017301038	1,704	0.982698962
2011	1,504	34	0.022606383	1,470	0.977393617
2012	1,562	28	0.017925736	1,534	0.982074264
2013	1,442	27	0.018723994	1,415	0.981276006
2014	1,408	19	0.013494318	1,389	0.986505682
2015	1,483	18	0.012137559	1,465	0.987862441
2016	1,527	16	0.010478062	1,511	0.989521938
2017	1,654	10	0.006045949	1,644	0.993954051
Total	15,102	239	0.015825718	14,863	0.984174282

Source: Authors' computation.

The results in Table 5 enables one to predict which month of the year mortality usually reduces but does not reveal whether there is improvement in healthcare delivery in terms of chance of infants survival for the years under investigation. Table 4 which reveals the yearly general infants crude death rates and survival rates of infants from 2008 to 2017 demonstrates this limitation. In 2008, infant mortality rate and survival rate are 18.5 per 1000 and 982 per 1000 respectively. In the second year, the mortality rate increased by 4 per 1000 to increase to 22 per 1000 while child survival correspondingly dropped by 4 per 1000 to reduced to 978 per 1000. In the third year, the mortality dropped by 5 per 1000 births and corresponding live births increased by 5 per 1000. However, in the fourth year (2011), infant mortality increased by 5 per 1000 to move to 23 per 1000 births. The corresponding survival rate decreased by 5 per 1000 ,to increase to 977 per 1000. From 2014 to 2017 of years under investigation, the mortality rates decreased by 0.005230, 0.001357, 0.001659, and 0.004432 to reduce the mortality rates to 13, 12, 10, and 6 per 1000 thereby increasing the survival rates from these years to 987, 988, 990, and 994 per 1000 live births. On the basis of the figures in Table 5, the mortality patterns of infants between year 2008 to 2013 are unstable. Meanwhile, there is an improvement in healthcare delivery as the mortality dropped steadily thereby increasing the infants' survival rates. The trend in mortality and survival rates is best explained in Figure 5a and 5b.





The survival curve demonstrates wave-like pattern starting at 0.98 in 2008, drops in 2009 and continue this pattern until attaining a local maximum in 2017 while the mortality pattern assumes a constant form.

3.2 Predicting the safest month of the years for infants survival

Figure 6 shows the overall crude survival rates for male and female live births. As can be seen in the figure, it is observed that the survival pattern is almost constant between January and November but assumed a slight increase in September indicating the safest month of the years for child delivery in JUTH.

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ISSN: 2016-1303 | ***Web:*** *www.cjpas.fulokoja.edu.ng*

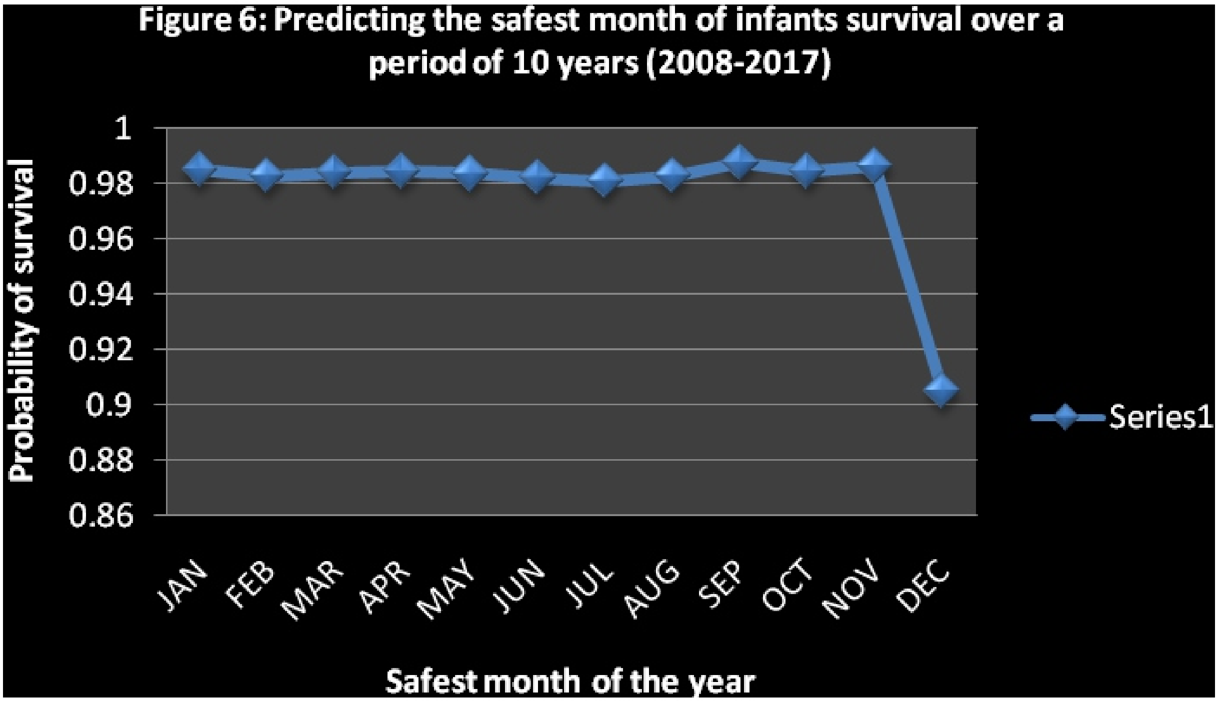

Table 6a: Infants quarterly specific crude death rates from 2008 to 2017

	Male		**Female**		**Crude death rate**	
Quarters	Exposed to risk	Death	Birth	Death	Male	Female
1ST QTR	631	11	602	9	0.016952	0.015016
2N QTR	639	10	568	10	0.015126	0.018097
3RD QTR	715	10	599	11	0.013632	0.019098
4TH QTR	661	9	619	55	0.013664	0.083561

Source: Authors' computation

Table 6a shows the quarterly specific crude death rates of male and female from 2008 to 2017. Having considered the safest month of the year through graphical line (Figure 6), it is important to also examine which quarter of the year over this period of 8 years (2008-2017) infants are more exposed to risk of death. From the table, first quarter shows that male (0.016952) is more exposed to risk of death than female (0.015016). However, in the second to fourth quarters, the risk of male child death is slightly lower than the female counterpart.

Using graphical method to represent this data, it is clear that male mortality is approximately constant throughout the period meaning that each quarter same numbers of death occur. Literarily this cannot happen; hence the gradient of the line is zero and is represented in line 017.0001.0+=*xy* with corresponding explained by 2*R*of 87.3%. Similarly, the female mortality varies correspondingly but somewhat shows a steady increase in risk of death than for the female with the regression line is 017.002.0–=*xy*with explained by of 64.8%.

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ISSN: 2016-1303 | ***Web:*** *www.cjpas.fulokoja.edu.ng*

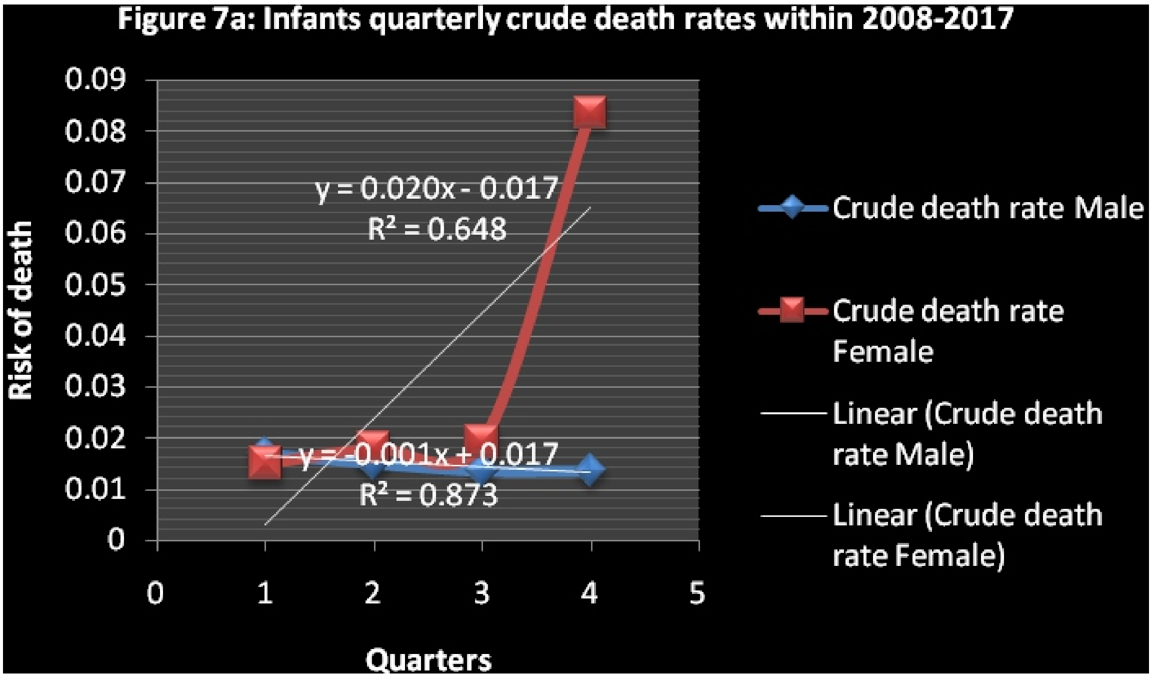
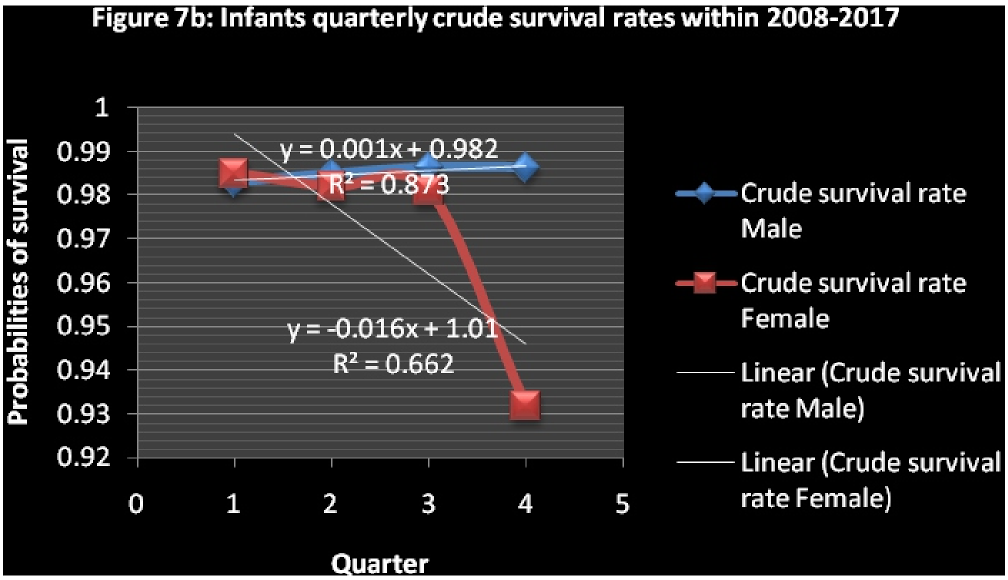


Table 6b: Infants quarterly specific survival rates in JUTH (2008 to 2017)

	Male		Female		Crude survival rate	
Quarters	Exposed to risk	Lives	Exposed to risk	Lives	Male	Female
1ST QTR	631	620	602	593	0.983048	0.984984
2ND QTR	639	630	568	558	0.984874	0.981903
3RD QTR	715	705	599	588	0.986368	0.980902
4TH QTR	661	652	619	574	0.986336	0.931788

Source: Authors' computation.

Just as Table 6a shows the risk of death, Table 6b contains computation of chance of survival for male and female over 8 years (2008-2017). The first quarter shows a slightly lower chance of male survival (0.983048) than for the female's (0.984984). Meanwhile, the second, third and fourth quarters showed that male survival rates are higher than that of female for the period under investigation. Figure 7b shows the patterns for male and female with corresponding linear equations.



3.3 Test of Hypotheses

In order to establish which of the gender has significant chance of survival or subject to mortality risk, the following hypotheses are tested using multiple regression.

Objective / hypothesis

To determine the effect of male birth rates and female birth rates on infants' survival from 2008-2017. Ho1: Male and female birth rates have no significant effect on infants survival from 2008-2017.

Table 7: Male and female survival rates influence on infants live births exposed to risks of infants (2008-2017)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	(Constant)	0.004	0.006		0.665	0.528
	MSR	0.532	0.009	0.511	59.4	0.000
2	FSR	0.464	0.007	0.565	65.657	0.000

a. Dependent Variable: CSR

Source: Authors' computation.

As shown in Table 7, both male and female survival rates have positive influence on infants survival rates for the period of years under investigation. The rate of change in male mortality is higher than that of male which means the equal units in both gender will lead to more males being born than the female. Based on these results, the null hypothesis is rejected and we conclude that male and female live births significantly lead to increase in infants' survival patterns.

Objective / hypothesis

To determine whether male birth rates and female birth rates have significant influence on infants live births exposed to risks of death from 2008-2017. Ho2: Male and female survival rates have no significant influence on infants live births exposed to risks of death from 2008-2017.

Table 8: Male and female survival rates impact on infants death rates

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	(Constant)	0.996	0.006		164.104	0.000
	MSR	-0.532	0.009	-0.511	-59.4	0.000
2	FSR	-0.464	0.007	-0.565	-65.657	0.000

a. Dependent Variable: CDR

Source: Authors' computation.

In Table 8, the male survival rates (MSR: Beta = -.532, $t = -59.400$, $p < 0.05$) and female survival rates (FSR: Beta = -.464, $t = -65.657$, $p < 0.05$) have negative and significant impact on infants exposed to risk where the rates of change in male survival rates implies increase in male birth significantly lead to reduction in infants mortality than that of female live births. On the basis of this result, the null hypothesis is hereby rejected and we conclude that male survival rates and female survival rates have significant impact on infants' mortality patterns

4.0 CONCLUSION

The study examined the rate of change in male mortality and female mortality rates and found that that of male is higher than that of male which means the equal units in both gender will lead to more males being born than the female. Consequently, the male survival rates and female survival rates have negative and significant impact on infants exposed to risk where the rates of change in male survival rates implies increase in male birth significantly lead to reduction in infants mortality than that of female live births. Regarding the months and quarters of the year consider safer for child delivery, our results showed that month of September of any years and third quarter of the year are respectively more safer for child delivery.

The data presented here are in respect of child births that have survived from age 0 to 2 over a period of 10 years. We are unable to obtained detailed data showing this age group as there is no comprehensive records but from the interview conducted with statistical records department, we are able to inquire that there was no follow up by the hospital to know how children given birth survived beyond this period but they were able to substantial through immunisation programme in which mothers were encouraged to participate for over a period of 1 to 2 years.

This study has been able to establish which months and quarter of the years are safer for infants' survival in Jos. Many studies carried out on issue concerning maternal and child mortality considered causes but ignored this aspect as there is no any empirical study being undertaken to have examined period of the years is safer for infants' survival.

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