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Perinatal Mortality in Rural Delta State, Nigeria

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Abstract
Perinatal Mortality in Rural Delta State Nigeria was Considered between 2005 – 2014. Out of 5160 deliveries, 480 Perinatal deaths were observed. Perinatal Mortality Rate was 93/1000 deliveries, Still Birth Rate was 51.2/1000 deliveries and Early Neo-Natal Death Rate was 41.3/1000 deliveries, A definite Trend in Perinatal Mortality defined by the linear mode $\hat{y}_t = 50.712 + 8.817t$ was observed. Perinatal Mortality Rate was highest amongst Infant ≤ 1000g of Weight (759.1/1000) also amongst Mothers Aged 35 years and above (128.7/1000) and also amongst Teenage Mothers (118.5/1000). Mother with No Education had rate as high as (213.6/1000) as compared to Educated Mothers (12.9/1000). Unbooked cases had a high PNMR (224.2/1000) as compared to Booked cases (21.6/1000). It was also observed that a week relationship exists between Perinatal Mortality and Sex of the Infant (P- value = 0.000, $\phi = 0.198$) while a strong relationship exists between Booking status and Perinatal Mortality and between Maternal Educational Status and Perinatal Mortality (P-value= 0.000, $\phi = 0.587$), (P- value= 0.000, $\phi = 0.730$) respectively. The null hypothesis that the independent variables as a group are not related to perinatal death was rejected at 5% level of significance (Omnibus Test of Model Coefficient; $\chi^2 = 944.041$, P-value= 0.000), the null hypothesis that the logistic model adequately fits the data was accepted at 5% level of significance (Hosmer and Lemeshow Test; $\chi^2 = 9.8990$, P-value= 0.2743). The odds of Perinatal death occurring is 1.433 times higher for Male Birth than they are for Female Birth, 2.807 times higher for babies born to Uneducated Mothers as opposed to Educated Mothers and 2.037 time higher for Unbooked cases than they are for Booked cases.
Keywords: Perinatal Mortality, Neonatal Death, Still Birth, Booked and Unbooked Cases, Gestational Age, Parity, Birth Weight, Delta State.

1.0 INTRODUCTION

Perinatal Mortality Continues to be a public health problem despite many years of research design to identify its risk factors. The World Health Organization defines perinatal Mortality as the number of still birth and early neonatal death per 1000 live birth. This is one of the most important vital Statistics that is used to measure how well a nation is fairing in terms of Maternal and Fetal outcome. Perinatal Mortality indicator plays an important role in providing the required information needed to improve the health Status of pregnant women, new mothers and new born, allowing decision makers to identify problems, tackle temporal and geographical trend and access changes in policy and practice.

Perinatal Morality in the 2013 National Demographic and Health Survey was highest amongst teenage mothers and mothers aged 40-49 (55/1000, 65/1000) respectively and lowest in urban residence (34/1000).

There is insufficient publication on Perinatal Mortality in rural regions of Delta State, thus, the aim of this study is to document Perinatal Mortality Statistics in the rural areas of Delta State, determine the Trend in Perinatal Mortality Rate and to determine whether or not the Independent Variables (Book Status, Sex of the Infant, Age of the mother, Maternal Educational Status, Gestational Age, Birth Weight and Parity) when Considered as a group Contribute to the likelihood of Perinatal Mortality.

2.0 METHODOLOGY

To achieve our set objectives, viz; to document perinatal mortality statistics in the rural areas of delta state, Nigeria, I'd review some models that we shall apply to our data.

2.1 Logistic Regression

$$P = \frac{e^{\alpha + \beta_o + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots + \beta_i X_i}}{1 + e^{\alpha + \beta_o + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots + \beta_i X_i}}$$

Here we consider the Logit transformation of
which can be written in the form

$$\text{Log}\,(P(x)) = \left\{\frac{P(x)}{1 - P(x)}\right\} = \alpha + \beta_1 X_1 + \beta_2 X_2 \ldots + \beta_i X_i$$

This implies; $\ln(\text{Odds}) = \alpha + \beta_1 X_1 + \beta_2 X_2 \ldots + \beta_i X_i$

To test for the significance of the parameters and/or coefficients we applied the Wald Statistics given as;

$$Z = \left(\frac{\hat{\beta}}{S.E} \right)^2$$

which asymptotically follows a χ^2 distribution with **1** degrees of freedom.

2.1.1 Hosmer - Lemeshow Goodness of Fit

Here we wish to check whether or not the observed event rates matched expected event rates in subgroups of the model population.

Hosmer - Lemeshow test is given as;

$$H = \sum_{g=1}^{G} \left\{ \frac{(O_g - E_g)^2}{N_g \pi_g (1 - \pi_g)} \right\}$$

which asymptotically follows a χ^2 distribution with **G-2** degrees of freedom.

2.1.2 The Omnibus Test of Model Coefficient

This test essentially is implemented on the overall hypothesis that tends to find the general significance between parameters while examining parameter variance of the same type, such as; hypothesis regarding equality vs. inequality between k-expectances.

H_o: $\mu_1 = \mu_2 = \ldots = \mu_k$

H_1: At least one pair $\mu_j \neq \mu_j^1$ where $j, j^1 = 1,2,\ldots,k$ and $j \neq j^1$

In Analysis of Variance (ANOVA); or regarding equality between k standard deviations

H_o: $\sigma_1 = \sigma_2 = \ldots = \sigma_k$

H_1: At least one pair $\sigma_j \neq \sigma_j^1$

In testing equality of variance in ANOVA, or regarding coefficients

H_o: $\beta_1 = \beta_2 = \ldots = \beta_k$

H_1: At least one pair $\beta_j \neq \beta_j^1$

2.2 TIME SERIES MODEL

Here we shall make use of the estimated model given by

where, $\hat{Y}_t = \hat{a} + \hat{b}\,\hat{t}$

$$\hat{a} = \left(\frac{\sum Y_t}{n} \right) - \hat{b} \left(\frac{\sum t}{n} \right)$$

$$\hat{b} = \frac{n \sum t Y_t - \sum t \sum Y_t}{n \sum t^2 - \left(\sum t \right)^2}$$

2.3 CHI - SQUARED TEST OF INDEPENDENCE

Finally, we considered the chi-squared test of independence in order to investigate the agreement between the observed and expected frequencies;

$$\chi^2 = \sum_i \sum_j \left\{ \frac{(O_{ij} - E_{ij})^2}{E_{ij}} \right\}$$

and test the hypothesis of independence

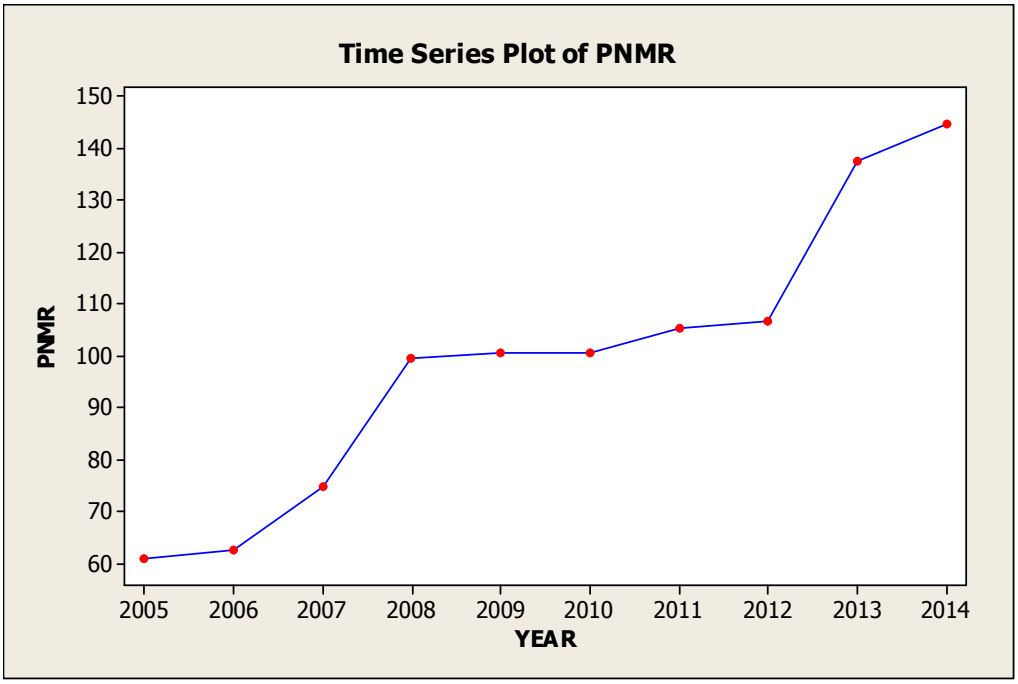
H_o: The Classification are independent
H_1: The Classification are independent
The Strength of the relationship Is determined using the phi - coefficient

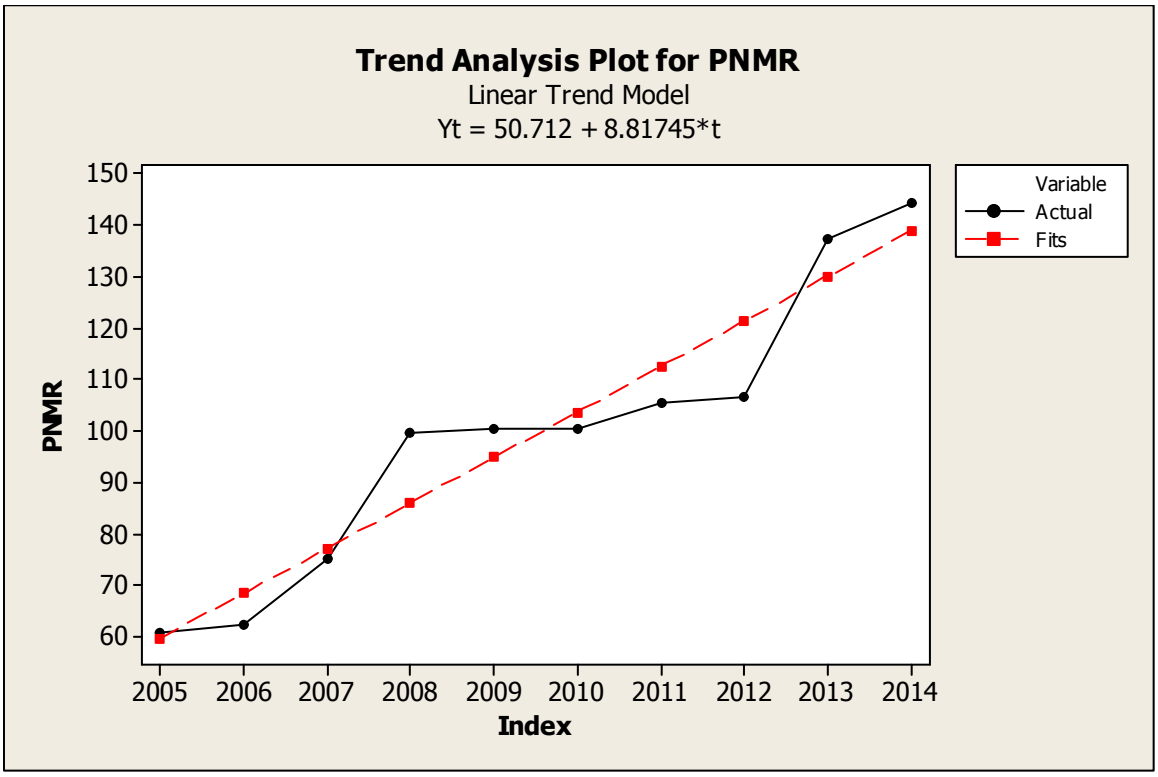
3.0 DATA ANALYSIS AND RESULTS

There were 5160 deliveries and 480 perinatal death. There were 230 male and 250 female perinatal death. The Perinatal Mortality Rate was 93/1000 deliveries, Still birth rate was 51.7/1000 deliveries and early neonatal death rate was 41.3/1000 deliveries.

Table 1: Trend in Perinatal Mortality

Year	Total Deliveries	Perinatal Death	P.N.M.R
2005	790	48	60.78
2006	481	30	62.37
2007	561	42	74.87
2008	553	55	99.46
2009	528	53	100.38
2010	488	49	100.41
2011	427	45	105.39
2012	411	47	106.58
2013	393	54	137.40
2014	498	57	144.46
	5160	480	93





The Time series plot shows the trend in Perinatal Mortality. There was a definite Trend in Perinatal Mortality Rate during the 10 year study period (defined by the Linear Model $\hat{Y}_t = 50.712 + 8.817t$), marked by a steady increase, with 2014 having the highest PNMR of 144.46/1000 deliveries and 2005 having the lowest PNMR of 60.76/1000 deliveries. This implies a steady increase in Perinatal Mortality in rural communities over time.

Table 2: Risk Factors and Perinatal Death

Factors	Perinatal Death	Total Deliveries	P.N.M.R
Booking Status			
Booked	72	3340	21.6
Unbooked	408	1820	224.2
Total	480	5160	93
Maternal Educational Status			
Educated	40	3100	12.9
Uneducated	440	2060	213.6
Total	480	5160	93
Gestational Age			
< 37 weeks	210	2202	95.4
> 37 weeks	270	2958	91.3
Total	480	5160	93
Parity			
0	106	1070	99.1
1	60	1139	52.7
2	70	908	77.1
3	53	670	79.1
4	80	670	119.4
≥ 5	111	703	157.9
Total	480	5160	93

Maternal Age			
< 20	120	1013	118.5
20 - 24	85	1180	72
25 - 29	92	1386	66.4
30 - 34	80	796	100.5
> 35	101	785	128.7
Total	480	5160	93
Birth Weight (g)			
1000	53	70	757.1
1001 - 1500	60	150	400.0
1501 - 2000	50	220	227.3
2001 - 2500	85	800	106.3
> 2500	232	3920	59.2
Total	480	5160	93

Table 2 shows that Perinatal Mortality decreases with increasing birth weight, with birth weight ≤ 1000g having the highest Perinatal Mortality Rate (757.1/1000) and birth weight > 2500g having the lowest of (52/1000). Perinatal Mortality amongst the Unbooked status were significantly higher (224.2/1000) when compared to the booked status (21.6/1000).

Table 3: Omnibus Test of Model Coefficient

		Chi-Square	df	Sig.
Step 1	Step	944.681	7	0.000
	Block	944.681	7	0.000
	Model	944.681	7	0.000

The Omnibus test of model coefficient test the hypothesis that the independent variables as a group are not related to the likelihood of Perinatal Mortality, which was rejected at a significance level of 5% (χ^2 = 944.684, Pvalue = 0.000). Hence the independent variables as a group are related to the likelihood of Perinatal Mortality.

Table 4: Variables In The Equation

		B	S.E	Wald	Df	Sig.	Exp (β)
Step 1	***Parity***	0.036	0.031	11.613	1	0.000	1.433
	Sex(1)	0.264	0.075	12.390	1	0.000	1.302
	Age of the Mother	0.080	0.012	44.444	1	0.000	1.083
	Booking Status(1)	0.712	0.184	14.974	1	0.000	2.037
	Maternal Educational Status(1)	1.032	0.204	25.592	1	0.000	2.807
	Gestational Age	0.318	0.034	87.478	1	0.000	1.374
	Birth Weight	0.302	0.078	14.991	1	0.000	1.353
	Constant	-0.283	0.094	9.064	1	0.000	0.754

The Fitted Model is

ln (Odds) = -0.283 + 0.360Parity + 0.264Sex(1) + 0.080Age of the Mother + 0.712Booking Status(1) + 1.032 Maternal Educational Status(1) + 0.318 Gestational Age + 0.032 Birth Weight.

3.1 Test of Parameter Significance

The Wald Statistic on table 4 tests the null hypothesis that the individual parameter does not make a significant contribution to the model. By comparing this statistics with $\chi^2_{0.05,\,1}$ the null hypothesis is rejected at α = 0.05. We therefore conclude that each of the parameter makes a significant contribution to the model (P-value < 0.05).

Table 5: Hosmer and Lemeshow Test for Goodness of Fit

Step	Chi-Square	Df	Sig.
1	9.8990	8	0.2743

The Hosmer and Lemeshow test, tests the null hypothesis that the model adequately fits the data which was accepted at a significant level of 5% (χ^2 = 9.8990, P-value = 0.2743).

Table 6: Odds Ratio

Variable in the Equation	Exp (β)
Parity	1.433
Sex(1)	1.302
Age of the Mother	1.083
Booking Status(1)	2.037
Maternal Educational Status(1)	2.807
Gestational Age	1.374
Birth Weight	1.353
Constant	0.754

Parity: For every unit increase in Parity, the odds of perinatal mortality occurring is 1.433 when all other independent variables are controlled.

Sex : The odds of Perinatal death occurring is 1.302 times higher for males than they are for females

Age of the Mother: For every unit increase in the Age of the mother, the odds of perinatal mortality occurring is 1.083 when all other independent variables are controlled.

Booking Status: The odds of Perinatal mortality occurring is 2.037 times higher for unbooked status as opposed to booked status.

Maternal Education (uneducated to educated): The odds of Perinatal mortality occurring is 2.807 times higher for babies born to uneducated mothers as opposed to educated mothers.

Gestational Age: For every unit increase in the gestational age (weeks), the odds of perinatal mortality occurring is 1.374 when all other independent variables are controlled.

Birth Weight: For every unit increase in the birth weight, the odds of perinatal mortality occurring is 1.353 when all other factors are controlled.

Table 7: Strength of Relationship Between Sex of The Infant and Perinatal Mortality

Symmetric Measure

		Value	Approx. SIg
Nominal by Nominal	Phi	-0.198	0.000
	Cramer's V	0.198	0.000

Here we see that the significance of the association between Sex of the infant and Perinatal Mortality Is trival.

Table 8: Strength of Relationship between Booking Status and Perinatal Mortality

Symmetric Measure

		Value	Approx. SIg
Nominal by Nominal	Phi	0.587	0.000
	Cramer's V	0.587	0.000

Here we see that the significance of the association exists between Booking Status and Perinatal Mortality is strong

Table 9 : Strength of Relationship between Maternal Educational Status and Perinatal Mortality

Symmetric Measure

		Value	**Approx. SIg**
Nominal by Nominal	Phi	0.730	0.000
	Cramer's V	0.730	0.000

Here we see that the significance of the association exists between Maternal Educational Status and Perinatal Mortality is strong

4.0 CONCLUSION

Perinatal Mortality Rate of 93/1000 was very high in this study. There has been no change in the PNMR when

this study period is compared with current findings in other states of the country. Unbooked Status was a significant risk factor for Perinatal Mortality and Low Birth weight was a common cause of Perinatal death.
Delta State Government and indeed Nigerian Government and all stake holders in healthcare delivery should ensure the provision of emergency obstetric care for all the women at all levels to reduce Perinatal death. Healthcare workers should be taught neonatal resuscitation and all neonates at birth especially high risk cases should be promptly resuscitated. The free infant and maternal healthcare program should extend to the rural communities and continue to be free in other to reduce the incidence of Unbooked Status.

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