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PERINATAL MORTALITY AND ASSOCIATED OBSTETRIC RISK FACTORS IN URBAN DELTA STATE, NIGERIA; RURAL-URBAN DIFFERENCES.

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ABSTRACT: *The Perinatal Mortality which is the number of stillbirths and early neonatal deaths per 1000 deliveries was discussed in this paper, with associated obstetric risk factors of which twenty seven risk factors were considered. Simple descriptive analysis, Independent t-tests, Time series analysis and Logistic Regression techniques was applied on a 10 year study from which 9018 deliveries resulting in 344 perinatal death were obtained. Perinatal Mortality Rate (PNMR), Still Birth Rate (SBR) and, Early Neonatal Death Rate (ENDR) were 38.15/1000, 26.17/1000, 11.98/1000 deliveries respectively. A linear trend in Perinatal Mortality given as* $\hat{y}_t = 91.1973 + 8.15788*t$ *was obtained. The null hypothesis of no significant difference between Perinatal mortality in the urban region and Perinatal mortality in the rural region of Delta State was rejected at 5% alpha level (t(18) = -4.336, p-value = 0.000). Ante partum Hemorrhage, Hypertensive Disorders, Abruptio Placentae, e.t.c. were found significantly causing 22.45%, 22.67%, 21.5%, of perinatal death cases in the state respectively. Hence these factors were considered the major risk factors associated with Perinatal Mortality in Urban Delta Sate Nigeria. Also, the logistic regression model adequately fits the data at 5% alpha level (Hosmer and Lemeshow test ;* $\chi^2 = 19.9190$, *p-value = 0.1463) and the significant risk factors as a group were related to the likelihood of Perinatal Mortality in Urban Delta Sate (Omnibus test of model coefficient;* $\chi^2 = 566.271$, *p-value = 0.000). For every unit increase in Ante Partum Hemorrhage, the odds of perinatal death occurring increases by 3.001 when all other variables are controlled.*

KEYWORDS*:* Perinatal Mortality, Obstetric Risks, Still Births, Early Neonatal Deaths, Odds Ratio.

INTRODUCTION

Perinatal death is defined as a death of a fetus in utero after the age of viability (Still birth) and deaths within the first 7 days of life (early neonatal death). Annually, an estimated 6.3 million babies die in the perinatal period globally, 98% of these occur in developing countries with Africa having the highest perinatal mortality rate at 56 deaths per 1000 birth (Ahman and Zepar, 2007). Reducing early neonatal mortality is warranted to achieve the millennium development goal 4 (MDG 4). Almost two-thirds of deaths occur in the first month of life. Among these, more than two-third die in their first week, of those who die in the first week, two-third die in the first 24hrs of life. (Beck et al, 2004). Perinatal mortality statistics is one of the important indicator used for evaluating the healthcare for mothers and their newborns, it is used to measure how well a nation is fairing in terms of maternal and fetal care and it also has a direct relationship with a nation's socio-economic advancement. Like maternal mortality, perinatal mortality is also preventable. This work therefore is aimed at; documenting perinatal mortality statistics and the associated significant obstetric risk factors in the ***Urban Areas Of Delta State,***

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and also determining by simple comparison, if there is a difference in Perinatal Mortality Rate between the Urban and Rural Areas of Delta State, Nigeria.

METHODOLOGY

To achieve the set objectives, some models were reviewed and applied which includes;

Independent Samples T-test

which compares two separate groups thus:

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{S_{\bar{x}_1 - \bar{x}_2}}$$

$$S^2_{pooled} = \frac{(df_1)s_1^2 + (df_2)s_2^2}{df_1 + df_2} \quad \underline{OR} \quad S^2_{pooled} = \frac{SS^2_1 + SS^2_2}{df_1 + df_2}$$

df_1 = df for 1st sample; n_1 - 1

df_2 = df for 2nd sample; n_2 - 1

$$S_{\bar{x}_1 - \bar{x}_2} = \text{sqrt}\ \{ \frac{(S^2_{pooled})}{n_1} + \frac{(S^2_{pooled})}{n_2} \}$$

Assumptions of the t-test

Shapiro-Wilk test of Normality

The Shapiro_Wilk test utilizes the null hypothesis principle to check whether a sample X_1 , . . . , X_n came from a normally distributed population. The null-hypothesis of this test is that the population is normally distributed. Thus, if the p-value is less than the chosen alpha level, then the null hypothesis is rejected and there is evidence that the data tested are not from a normally distributed population. The test statisticis:

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$$W = \frac{\left(\sum_{i=1}^{n} a x_{(i)}\right)^2}{\sum_{i=1}^{n} (x_i - \bar{x})^2}$$

$$(N - K) \quad \sum_{i=1}^{i} N_i (Z_i - Z..)$$

Levene's test for Equality of Variance

To assess the equality of variances for a variable calculated for two or more groups, the Levene's test was applied. It tests the null hypothesis that the population variances are equal (called homogenuity of variance or homoscedasticity). if the resulting p-value of Levene's test is less than some significance level, then the null hypotthesis of equal variance is rejected and it is concluded that there is a difference between the variances in the population. The test statistic is;

$$W = \frac{(N - k)}{(k - 1)} \frac{\sum_{i=1}^{k} N_i (Z_{i.} - Z_{..})^2}{\sum_{i=1}^{k} \sum_{j=1}^{N_i} (Z_{ij} - Z_{i.})^2}$$

The significance of W is tested against $F(\alpha, k - 1, N - k)$.

Logistic Regression

Bearing in mind that our dependent variable in dichotomous, we apply the Logistic regression technique to obtain a Logistic model that helps us in obtaining the likelihood of perinatal mortality occurring giving a particular exposure which can be written in the form:

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

This implies;

$$\ln (Odds) = \alpha + \beta_1 X_1 + \beta_2 X_2 \ldots + \beta_i X_i$$

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Wald Test

To test for the significance of the parameters and/or coefficients considered in this study 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.

Hosmer - Lemeshow Goodness of Fit

To check if the observed event rate matched the expected event rate in subgroup of the modeled population, the Hosmer-Lemeshow test was applied. Giving by the statistic;

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

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

The Omnibus Test of Model Coefficient

The omnibus test relates to the hypothesis

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

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

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.

Time Series Model

The time series model was used to obtain the trend.

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

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

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

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Data Analysis and Results

Table 1: Frequencies of Deliveries, Deaths And Rates.

	TD	SB	END	PD	S.B.R	E.N.D.R	P.N.M.R
2005	*421*	*29*	*9*	*38*	*68.88*	*21.38*	*90.26*
2006	*464*	*23*	*18*	*41*	*49.57*	*38.79*	*88.36*
2007	*518*	*30*	*6*	*36*	*57.92*	*11.58*	*69.50*
2008	*920*	*18*	*20*	*38*	*19.57*	*21.74*	*41.30*
2009	*1117*	*36*	*10*	*46*	*32.23*	*8.95*	*41.18*
2010	*968*	*17*	*15*	*32*	*17.56*	*15.50*	*33.06*
2011	*725*	*14*	*7*	*21*	*19.31*	*9.66*	*28.97*
2012	*1391*	*35*	*4*	*39*	*25.16*	*2.88*	*28.04*
2013	*1208*	*19*	*9*	*28*	*15.73*	*7.45*	*23.18*
2014	*1286*	*15*	*10*	*25*	*11.66*	*7.78*	*19.44*
TOTAL	**9018**	**236**	**108**	**344**	**26.17**	**11.98**	**38.15**

TD - Total Deliveries, SB- Still Birth, END- Early Neonatal Death, PD- Perinatal Death, S.B.R- Still Birth Rate, E.N.D.R - Early Neonatal Death Rate, P.N.M.R- Perinatal Mortality Rate.

Fig 1: Time series plot of P.N.M.R, S.B.R and E.N.D.R

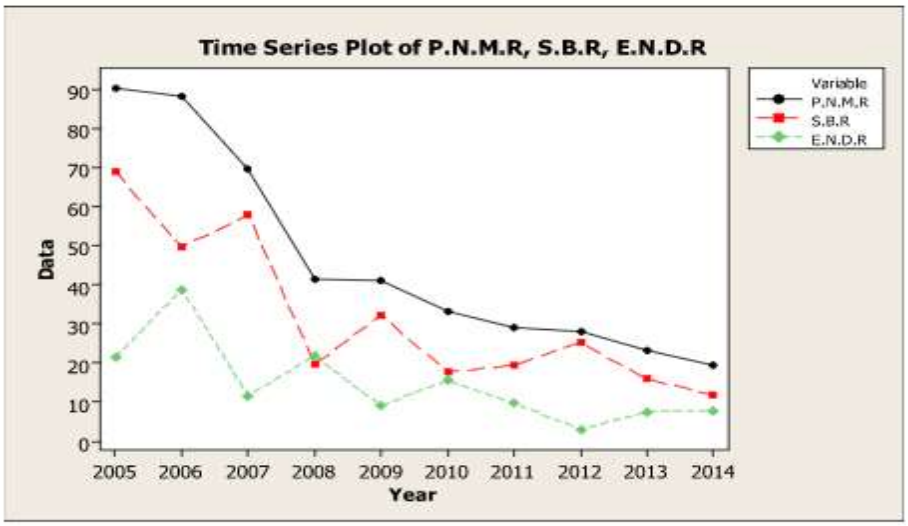

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Fig 2: Trend Analysis plot for P.N.M.R

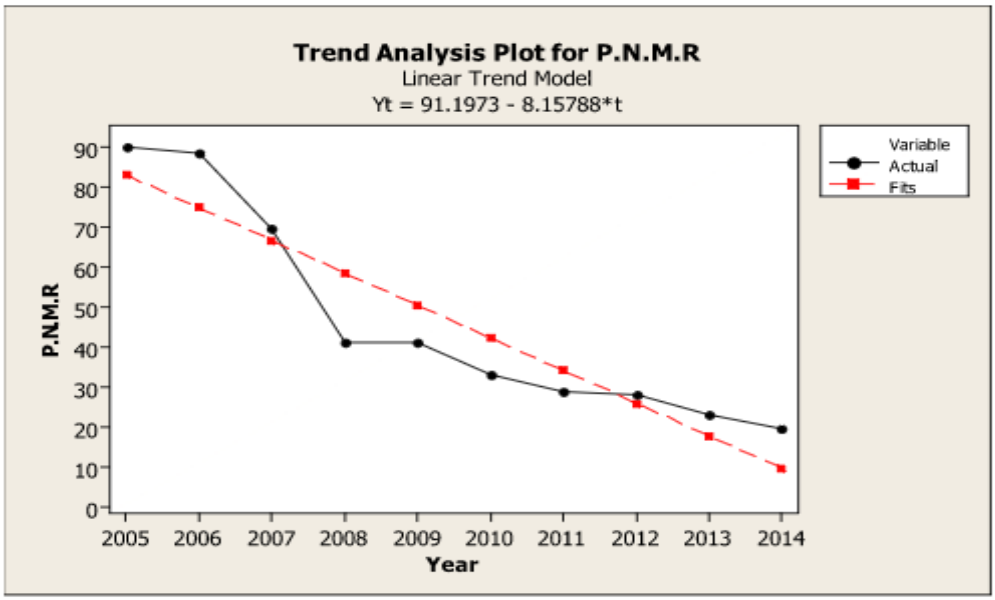

Fig 3: Residual Plots for P.N.M.R

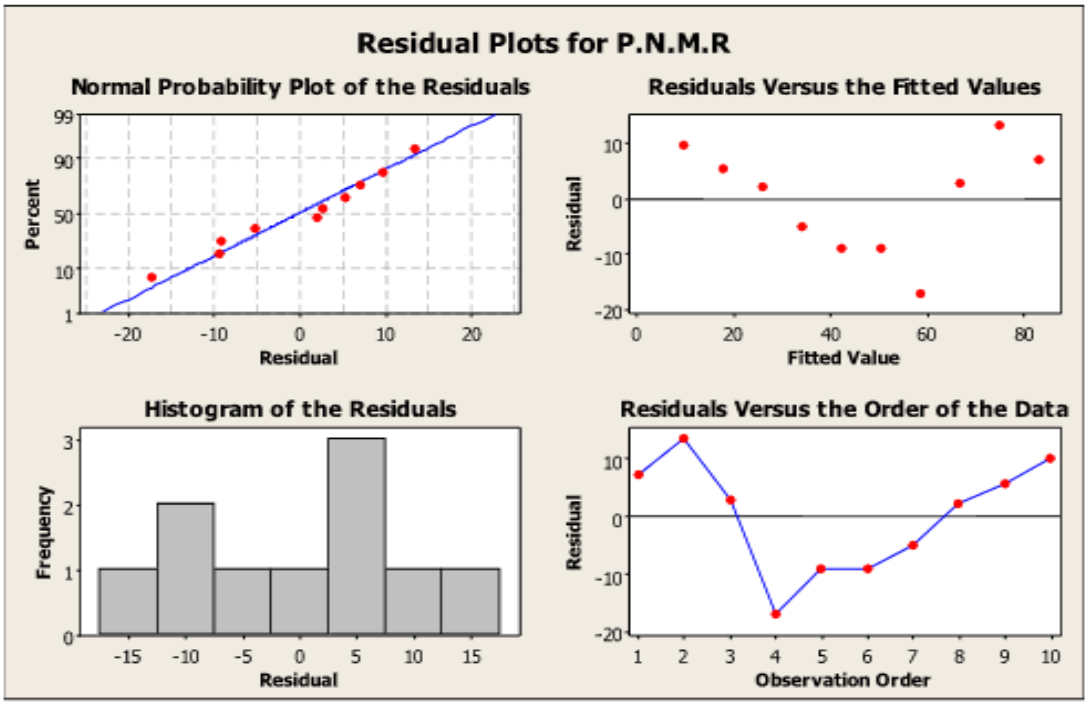

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Fig 4: Trend Analysis Plot for S.B.R

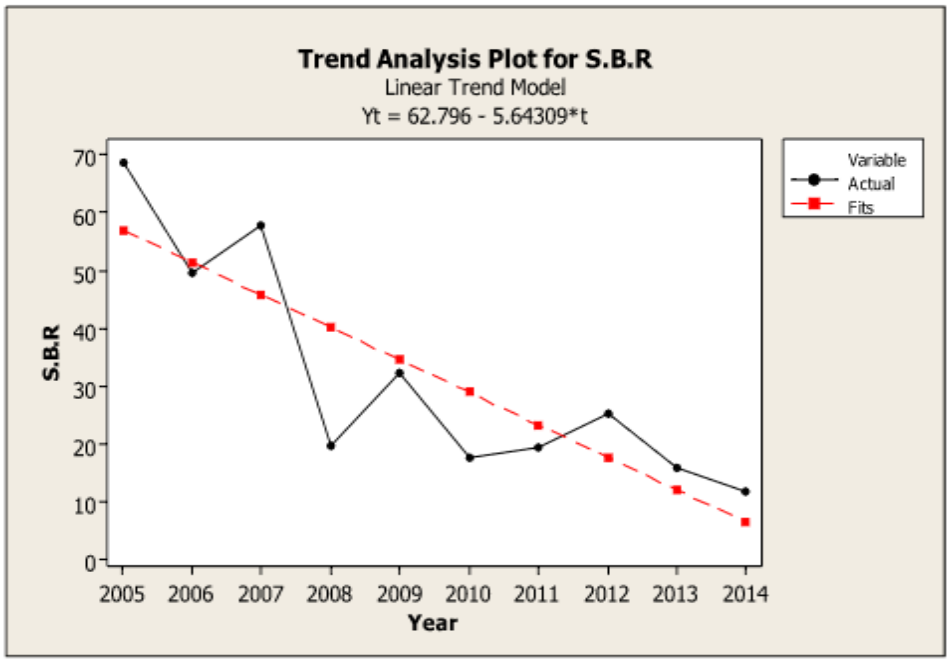

Fig 5: Residual plots for S.B.R

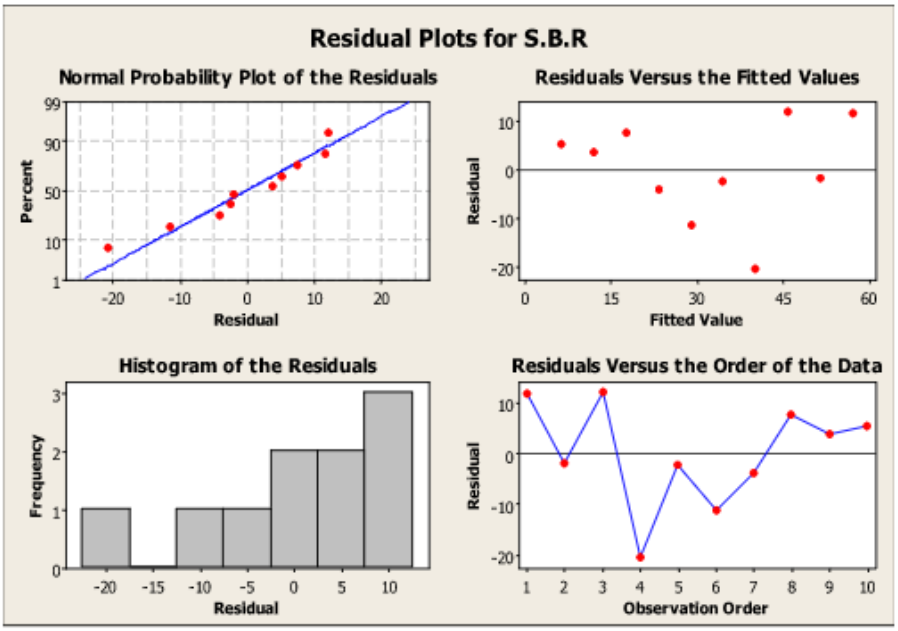

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Fig 6: Trend Analysis plot for E.N.D.R

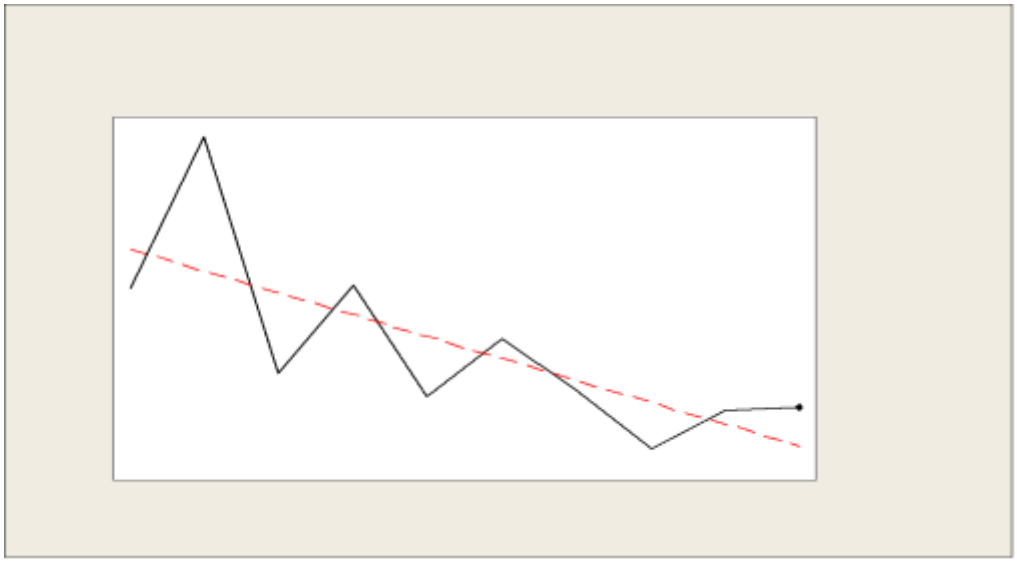

Fig 7: Residual Plots for ENDR

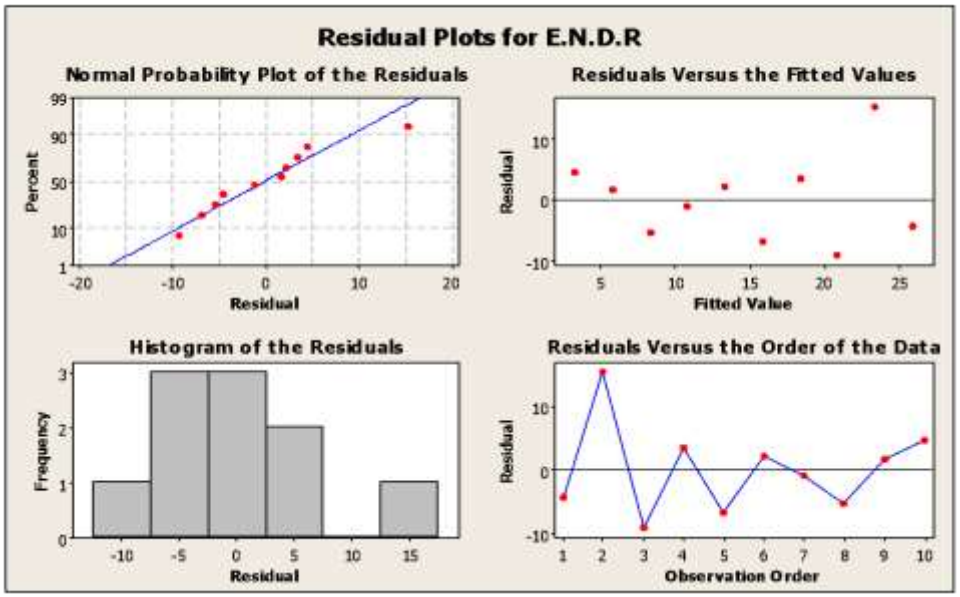

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Table 2: Information on Perinatal Mortality Rate Obtained from A Rural Study.

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
P.N.M.R	60.78	62.37	74.87	99.46	100.38	100.41	105.39	106.58	137.40	144.46

Total Perinatal Death = 480, Total Deliveries = 5160, PNMR = 93/1000, SBR = 51.7/1000, ENDR = 41.3/1000

Table 3: PNMR Urban/Rural Study.

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
PNMR (RURAL)	60.78	62.37	74.87	99.46	100.38	100.41	105.39	106.58	137.40	144.46
PNMR (URBAN)	90.26	88.36	63.50	41.30	41.18	33.06	28.97	28.04	23.18	19.44

Extracted from: Osuji, G.A; Obubu, M; and Nwosu, D.F. "Perinatal Mortality in Rural Delta *State, Nigeria." Journal of Natural Sciences Research, Vol 5, No 14 Pp. 8-14, 2015.*

Table 4: Normality Testing

	Test of Normality		
	Shapiro-Wilk		
	Statistics	df	Sig.
PNMR URBAN	.834	10	.073
PNMR RURAL	.916	10	.322

Table 5: Test For Independence

Chi-Square Tests			
	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	20.000	19	.395
Likelihood Ratio	27.726	19	.089
Linear-by-Linear Association	9.708	1	.002
N of Valid Cases	20		

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Table 6: T - Test

Independent Samples Test						
		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
PNMR	Equal variances assumed	.070	.794	-4.336	18	.000
	Equal variances not assumed			-4.336	17.955	.000

Out of 9018 deliveries, 388 perinatal deaths were observed. The PNMR was 38.15/1000 deliveries, SBR was 26.17/1000 deliveries, and ENDR was 11.98/1000 deliveries. The Trend Analysis plot shows the Trend in Perinatal Mortality Rate, Stillbirth Rate, and Early neonatal Death Rate. There was a definite Trend in Perinatal Mortality Rate during the 10 year study period *($\hat{Y}_t$ = 91.1973 - 8.15788*t)*, marked by a steady decrease. We notice a large decrease in PNMR between year 2007 and 2008 (from *69.50/1000* to *41.30/1000* deliveries) despite increase in deliveries from 518 to 920 birth and this was due to the commencement of the Delta State Free Maternal Healthcare Programme initiated by the state government in 2008. An Independent t-test was performed on the data to find out if there is a Significant Difference in PNMR in Urban Delta State and PNMR in Rural Delta State, at 5% level of significance, the data showed no violation to the assumptions of Normality (*Shapiro-wilk p-value = .073,* .322 *for Urban, rural respectively*), Homogeneity of variance (*Levene's Statistic = .070, p-value =* .794)**,** and Independence (*Pearson chi-square value = 20.000, p-value* = .395). The null hypothesis of no significant difference in PNMR between the Urban and Rural areas of Delta State Nigeria, was rejected at 1% alpha level *(t(18) = -4.336, p-value = 0.000)*. Urban Statistic*: Total Perinatal death = 344, Total Deliveries = 9018, PNMR = 38.15/1000, SBR = 26.17/1000, ENDR = 11.98/1000*. Rural Statistic: *Total Perinatal death = 480, Total Deliveries = 5160, PNMR = 93/1000, SBR = 51.7/1000, ENDR = 41.3/1000 deliveries.*

Factors Associated With Perinatal Death

Table 7: Maternal Demographic Xter

Variable	Frequency	Percentage
Booking Status		
Booked	65	18.90
Un-booked	279	81.10
Maternal Age (yrs)		
< 20	232	67.44
20 - 30	34	9.88
>30	78	22.67

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Parity Primiparae Para 1 - 5 > 5	20 270 54	5.81 78.49 15.70
Gestational Age (wks) 24 - 31 + 6 32 - 36 + 6 >37	110 144 90	31.98 41.86 26.16

Table 8: Risk Factors

RISK FACTORS	No. of Patients	Percentage
Ante Partum Hemorrhage	91	26.45
Abruptio Placentae	74	21.51
Placenta Previa	23	6.69
Hypertensive Disorders	78	22.67
Eclampsia	58	16.86
Pre - Eclampsia	15	4.36
Mechanical Causes	58	16.86
Prolonged / Obstructed Labour	36	10.47
Ruptured uterus	16	4.65
Cord Prolapse	13	3.78
Congenital Abnormalities	25	7.27
Hydrocephalus	19	5.52
Anencephaly	19	5.52
Spina bifida	14	4.07
Non Immune Hydrops	13	3.78
Multiple Fetal defects	12	3.49
Maternal Medical Disorders	15	4.36
Diabetes mellitus	19	5.52
Hepatic Failure	3	0.87
Chorioamnionitis / Septicaemia	19	5.52
Multiple Pregnancy	15	4.36

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Table 9: Birth Weight

Weight in kg	No. of Patients	Percentage
< 1.5	158	45.93
1.5 - 2.5	65	18.89
2.5 - 4	53	15.41
> 4	68	19.77

From the 344 cases of perinatal deaths recorded in this study, 279 (81.10%) cases were due to unbooked cases, as a large number of women do not seek antenatal care during the period of pregnancy, majority of the unbooked women belonged to poor social class, similar findings was obtained by Osuji et al (2015) when studying Perinatal Mortality in Rural Delta State, Nigeria. Perinatal death was highest amongst teenage mothers (232 cases representing 67.5%) and amongst mothers above 30 years of age (78 cases representing 22.67%) while Osuji et al (2015) have reported that teenage mothers and mothers ≥ 35 years of age have twice higher risk of perinatal death. Also, mothers Para 1 - 5 shows a higher perinatal mortality compared to primiparae and grand multiparae while Osuji et al (2015) reported that primiarae and babies born after the 5th child are at greater risk. Meanwhile, preterm deliveries and low birth weight < 1.5kg carry a high risk of perinatal death as seen in this study. The most obstetric risk factor in this study were Ante Partum hemorrhage, followed by hypertension disorders of pregnancy. The higher perinatal mortality related to Labour difficulties remains an ever known obstetric risk factor, we observed Obstructed / Prolonged Labour in 36 women (10.47%) whereas, it is the most common cause of Still Birth in the study conducted by Joy et al in 2010., this may be due to expanding maternity services in the urban regions of delta state at secondary health care centers as well as private maternity units where facility for caesarean section are available 24 hours of the day. Abruptio Placentae was found in 74 (21.51%) cases, Eclampsia in 58 (16.86%) cases, also, Diabetes Mellitus was found in 19 (5.52%) cases e.t.c. A large majority of risk factors for perinatal mortality are preventable if detected earlier and treated properly.

Table 10: Omnibus Test Of Model Coefficient

		Chi-Square	df	Sig.
Step 1	Step	566.271	16	0.000
	Block	566.271	16	0.000
	Model	566.271	16	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 = 566.271, P-value = 0.000). Hence the independent variables as a group are related to the likelihood of Perinatal Mortality.

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Table 11: Variables in the Equation

	β	S.E	Wald	Df	Sig.	Exp (β)
Parity	0.311	0.072	18.658	1	0.000	1.365
Sex(1)	0.074	0.092	0.647	1	0.092	1.077
Age of the Mother	0.247	0.069	12.814	1	0.000	1.280
Booking Status(1)	0.334	0.112	8.893	1	0.000	1.397
Gestational Age	0.012	0.041	0.086	1	0.611	1.012
Birth Weight	0.018	0.061	0.087	1	0.302	1.018
Diabetes Mellitus	0.039	0.104	0.141	1	0.891	1.040
Ante Partum Hemorrhage	1.099	0.118	86.742	1	0.000	3.001
Abruptio Placentae	0.896	0.092	94.851	1	0.000	2.450
Hypertensive Disorders	0.432	0.106	16.609	1	0.000	1.540
Eclampsia	0.023	0.016	2.066	1	0.142	1.023
Prolonged / Obstructed Labour	0.008	0.012	0.444	1	0.099	1.008
Ruptured uterus	0.011	0.062	0.031	1	0.623	1.011
Congenital Abnormalities	0.037	0.065	0.324	1	0.188	1.038
Hydrocephalus	0.003	0.008	0.141	1	0.257	1.003
Anencephaly	0.041	0.106	0.150	1	0.441	1.042
Constant	0.264	0.088	9.000	1	0.000	1.302

The Fitted Model is:

ln (Odds) = 0.264 + 0.311Parity + 0.247Age of the Mother + 0.334Booking Status(1) + 1.099 Ante Partum Hemorrhage + 0.896Abruptio Placentae + 0.432 Hypertensive Disorders.

Test of Parameter Significance

The Wald Statistic on table XI 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 $\alpha = 0.05$ for variables with P-value > 0.05. We therefore conclude that the significant risk factors for Perinatal Mortality in Urban Delta State Nigeria are; Ante Partum Hemorrhage, Abruptio Placentae, Hypertensive Disorders, Parity, Age of the Mother, and Booking Status.

Table 12: Hosmer and Lemeshow Test for Goodness of Fit.

Step	Chi-Square	Df	Sig.
1	19.9190	17	0.1463

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 = 19.9190, P-value = 0.1463).

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Table 13: Odds Ratio

Variable in the Equation	Exp (β)
Parity	1.365
Age of the Mother	1.280
Booking Status(1)	1.397
Ante Partum Hemorrhage	3.001
Abruptio Placentae	2.450
Hypertensive Disorders	1.540
Constant	1.302

Parity: For every unit increase in Parity, the odds of perinatal mortality occurring is 1.365 when all other independent variables are controlled.

Age of the Mother: For every unit increase in the Age of the mother, the odds of perinatal mortality occurring is 1.280 when all other independent variables are controlled.

Booking Status: The odds of Perinatal mortality occurring is 1.397 times higher for unbooked status as opposed to booked status when all other independent variables are controlled.

Ante Partum Hemorrhage: For every unit increase in ante partum hemorrhage, the odds of perinatal mortality occurring is 3.001 when all other independent variables are controlled.

Abruptio Placentae: For every unit increase in Abruptio placentae, the odds of perinatal mortality occurring is 2.450 when all other factors are controlled.

Hypertensive Disorders: For every unit increase in hypertensive disorders, the odds of perinatal mortality occurring is 1.540 when all other factors are controlled.

CONCLUSION

The Delta State Free Maternal Healthcare Program established by the state government in 2008 has significantly reduced perinatal death in urban delta state to as low as 38.15/1000 deliveries, which is significantly lower than the rate obtain in a rural study by Obubu et al (2015). We therefore conclude that for the MDG in this area to be achieved completely, efforts must be made by government to introduce the Free Maternal Healthcare program in the rural area.

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