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FOREWORD

I warmly welcome all and sundry to the volume 3 issue 1 of Federal Polytechnic – Journal of Pure and Applied Sciences (FEPI-JOPAS) which is a peer reviewed multi-disciplinary accredited Journal of international repute. FEPI-JOPAS publishes full length research work, short communications, critical reviews and other review articles. In this issue, readers will find a diverse group of manuscripts of top-rated relevance in pure and applied science, engineering and built environment. Many of the features that you will see in the Journal are result of highly valuable articles from the authors as well as the collective excellent work of our managing editor, publishing editors, our valuable reviewers and editorial board members.

In this particular issue, you will find that Joseph and Adebanji provided innovative technology on light traffic control system. Ogunkoya and Sholotan engaged standard method for microbiological assessment of shawarma from Igbesa metropolis for possible microbial contamination. Ilelaboye and Kumoye unveiled the effect of inclusion of different nitrogen source on growth performance of mushroom. Ogunyinka et al utilized Fletcher Reeves conjugate gradient method as a robust prediction model for candidates' admission to higher institutions. Omotola and Fatunmbi examined the impact of thermal radiation with convective heating on magnetohydrodynamic (MHD), incompressible and viscous motion of non-Newtonian Casson fluid. Aako and Are meticulously investigated factors affecting mode of delivery using binary dummy dependent models. Abiaziem and Ojelade successfully synthesized biologically active silver nanoparticles using *Terminalia catappa* bark as the eco-friendly source.

In addition, Olowosebioba et al. assessed the rectifying effects of various diodes in power supply units using multisim circuit design software programme. Olujimi et al. successfully accomplished the use of fingerprint based biometric attendance system for eliminating examination malpractices with enhanced notification. Alaba reported the nutritional status assessment of school age children (6-12 years) in private primary school in Ilaro. Muhammed-lawal et. al. assessed the execution and effect of corporate social responsibilities and return to marketing. Awolola and Sanni's research was about achieving quality of engineering education and training in Nigeria using Federal Polytechnic, Ilaro as the case study. Oladejo and Ebisin expatiated on virtual laboratory as an alternative laboratory for science teaching and learning.

Finally, Aneke and Folalu investigated the prospect and problems of the hotels in Ilaro, Ogun State.

I would like to thank and extend my gratitude to my co-editors, editorial board members, reviewers, members of FEPI-JOPAS, especially the Managing Editor, as well as the contributing authors for creating this volume 3 issue 1. The authors are solely responsible for the information, date and authenticity of data provided in their articles submitted for publication in the Federal Polytechnic Ilaro – Journal of Pure and Applied Sciences (FEPI-JOPAS). I am looking forward to receiving your manuscripts for the subsequent publications.

You can visit our website (https://www.fepi-jopas.federalpolyilaro.edu.ng) for more information, or contact us via e-mail us at fepi.jopas@federalpolyilaro.edu.ng.

Thank you and best regards.

E-Signed
Prof. Olayinka O. AJANI

FEPI-JOPAS VOLUME 3 ISSUE 1 TABLE OF CONTENTS

FEPI-JOPAS VOLUME 3 ISSUE 1 TABLE OF CONTENTS

FEPI-JOPAS VOLUME 3 ISSUE 1 TABLE OF CONTENTS

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Modeling Mode Of Childbirth Delivery Using Dummy Dependent Variable Models

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Abstract
In many applications, the dependent variable is nominal or ordinal, thereby, standard linear model is not suitable for modeling such dependent variables. Mode of delivery is nominal; it is either by spontaneous vaginal delivery or by caesarean section (CS). This study then investigates factors affecting mode of delivery using binary dummy dependent models. Data on mode of delivery and risk factors such as Mother's age (years), child's sex, child's weight (kg), child's length (cm), child's head circumference (cm) and mode of delivery were collected from State Hospital Ota, Ogun State over a period of eight months in order to identify factors that affect mode of delivery. Binomial logistic and probit regression models were fitted into the data to determine the preferred model for the analysis of mode of delivery. AIC was used to determine the competence of the models. Probit model with the lower AIC was found to be more adequate for the data and was used to identify the factors affecting mode of delivery. The result showed that maternal age and child's weight have significant effects on the probability of having a child through CS. Also, children with head circumference less than 35 cm are less likely to deliver via CS than those with head circumference between 20-35 cm, though not significant. It is recommended that the health practitioners should take cognizance of the factors affecting mode of delivery as identified by this research work.

***Keywords*:** Binomial logistic regression, Caesarean section, Probit regression, Risk factors, Vaginal delivery

INTRODUCTION

Childbirth, preceded by labour and delivery, ends pregnancy duration where one or more babies leave the uterus by spontaneous vaginal delivery or by caesarean section (CS). Child birth is associated with very serious labour pain. Most women describe the pain as most rigorous pain experienced (Gau *et al.,* 2011). Spontaneous Vaginal Delivery (SVD) is viewed as a natural process of giving birth and the most widely acceptable and preferred delivery (Ibtisam and Kareem, 2018). Caesarean Section (CS) is preferred by women who fear the pain associated with vaginal delivery (Aleese and Nuttall, 2000) and even recommended for those with complications. One of the key goals of every medical squad dealing with child birth is to perform a safe delivery (Lori, 2009). But when it is impossible to have the baby through SVD, the alternative mode of delivery is by CS (Farhana *et al.,* 2019).

The importance of CS deliveries is recognized globally for dealing with complications associated with childbirth and reducing the mortality rates of mothers and foetus (Betran *et al.,* 2015). Lumbiganon *et al.* (2010) opined that many mothers refuse to accept CS because of its associated adverse effects compared to SVD. In Nigeria, CS rate varies from one region to the other and shown a rising trend of 10.4%, 25.3%, 27.6% in 1989, 2005 and 2011 respectively (Onoh *et al.,* 2015). Increasing in CS rate has prompted professionals to research into the medical and non-medical prognostic factors accountable for the increase. Hence, it is necessary to identify the most prognostic factors and their individual contribution to mode of delivery.

Dummy variable regression model is an alternative to the linear regression where the normality assumption fails in case of binary categorical or multi-categorical discrete variable. Dummy variables are nominal and/or ordinal scaled variables which have to be converted into 0/1 coding. Binary dependent models yield a set of coefficients that parameterize the effect of independent variables on the dependent one, thus providing information on sign and significance. Due to the difficulties in the interpretation, it is common practice to evaluate the change in the predicted probability induced by a small change in the dependent variable. Logit and Probit models are used to model association between a dummy endogenous variable and one or more exogenous variables.

Many researches have been done in the past regarding mode of delivery. Mahmut Kiliç (2012) established the delivery preferences among women giving birth in

hospitals and the factors affecting their preference. Zakerihamidi *et al.* (2014) studied pregnant women's beliefs about vaginal delivery and CS as it affects their decisions about the mode of delivery. Alice *et al.* (2015) worked on factors influencing the decision that women make on their mode of delivery using cross-sectional study method. The results showed that women prefer CS and perceived that CS is a more convenience way to deliver.

Ezugwu *et al.* (2017) worked on CS rate and its outcome in a tertiary hospital in Enugu, South East, Nigeria. The aim was to determine the CS rate and its outcome at the University of Nigeria teaching hospital, Enugu. The CS rate from the study was high, although with good outcome. Abbas *et al.* (2018) studied the prevalence and determinants of Caesarean delivery using multivariate logistic regression analysis. The result showed that place of delivery and number of antenatal care visits had a significant impact on the rate of CS. Adewuyi *et al.* (2019) investigated the prevalence and associated factors on caesarean section in Nigeria and concluded that there was a considerably low prevalence of caesarean delivery. Wondie *et al.* (2019) studied the prevalence of Cesarean delivery among women who gave birth in Dessie town hospitals, Ethiopia and found that CS delivery prevalence was higher in private hospitals than a public facility.

In this study, some risk factors leading to women having CS delivery such as maternal age at birth, child's weight, child's length, child's head circumference would be investigated using dummy dependent variable regression models.

MATERIALS AND METHODS

Materials

The data for this study was source from General Hospital Ota, Ogun State, Nigeria. The mode of delivery records in the hospital for 395 women, who gave live birth from March to October, 2019 was extracted. Data on risk factors such as Mother's age (years), child's sex, child's weight (kg), child's length (cm), child's head circumference (cm) and mode of delivery (CS or SVD) were collected in order to identify factors that affect mode of delivery. The data was coded as follows; Mode of delivery: $CS=1, SVD=0$;Maternal age: $25=0, 25-35=1, >35=2$; Sex: Female=1, Male=0; Child's weight: $\leq 2.5=0, 2.6-3.0=1, >3.0=2$; Child's length: $30-39=0, 40-49=1, >49=2$; Head Circumference:$20-35=0, >35=1$. Table 1 presents the description of different categories of data in percentage.

Table 1: Descriptive Table

		Number	Percentage
Mode of Delivery	CS	159	40.3
	SVD	236	59.7
Maternal Age	< 25	55	13.9
	25-35	274	69.4
	>35	66	16.7
Sex	Male	207	52.4
	Female	188	47.6
Head circumference	20-35	273	69.1
	>35	122	30.9
Child's length	30-39	13	3.3
	40-49	317	80.3
	>49	65	16.4
Child's weight	<=2.5	41	10.4
	2.6-3.0	152	38.5
	>3.0	202	51.1

Methods

Binomial logistic regression model

The Logit model uses the standard logistic distribution whose cumulative distribution function is

$$F(x)=\frac{e^x}{1+e^x}$$

Consider independent variables X_i and the dependent variable Y, a binomial logistic regression model is given as follows:

$$logit(p)=\log\left(\frac{p}{1-p}\right)=\beta_0+\beta_1 X_1+\beta_2 X_2+\ldots+\beta_k X_k+\varepsilon. \quad (1)$$

where β_0=constant coefficient, β_k=coefficient of $X_k, X_1,\ldots,X_k$ are independent variables, $k=1,2,\ldots$ and ε= error term.

Exponentiating equation 1 and taking the inverse of both sides,

$$\frac{1-p}{p}=\frac{1}{\exp\left(\beta_0+\beta_1 X_1+\beta_2 X_2+\ldots+\beta_k X_k\right)}$$

$$\frac{1}{p}=1+\frac{1}{\exp\left(\beta_0+\beta_1 X_1+\beta_2 X_2+\ldots+\beta_k X_k\right)}$$

$$\frac{\exp\left(\beta_0+\beta_1 X_1+\beta_2 X_2+\ldots+\beta_k X_k\right)+1}{\exp\left(\beta_0+\beta_1 X_1+\beta_2 X_2+\ldots+\beta_k X_k\right)}$$

Therefore, the probability P(Y=1) is

$$P=\frac{\exp\left(\beta_0+\beta_1 X_1+\beta_2 X_2+\ldots+\beta_k X_k\right)}{1+\exp\left(\beta_0+\beta_1 X_1+\beta_2 X_2+\ldots+\beta_k X_k\right)} \quad (2)$$

Probit Regression Model

The probit model uses the standard normal distribution whose cumulative distribution function, ∅ is

$$\varnothing(x)=\int_{-\infty}^{x}\frac{1}{\sqrt{2\pi}}\exp\left\{\frac{-1}{2}t^2\right\}dt$$

The index $\beta_0+\beta_1 X_1+\beta_2 X_2+\ldots+\beta_k X_k$is treated as a Z-score.

$$P\left(Y=1\middle| X_1,\ldots,X_k\right)=\varnothing\left(\beta_0+\beta_1 X_1+\beta_2 X_2+\ldots+\beta_k X_k\right); k=1,2,3,\ldots \quad (3)$$

Logit and Probit models in equations 2 and 3 require numerical methods to find $\hat{\beta}$'s that best fit the data. Hence, the estimation of the models is done by maximum likelihood estimation method using R-software package.

Model Selection

Akaike Information Criterion (AIC) is used as a measure of the goodness of fit of the estimated models. AIC measures the quality of the model

and compares relatively similar models. The preferred model is the one with the lowest AIC.

$$AIC = -2lnL(\theta_n / Y_n) + 2k. \quad (4)$$

where L=log-likelihood and *k* is the number of parameters.

RESULTS AND DISCUSSION

Results

Table 2: Binomial logistic regression coefficients, standard errors and p-values

	Estimate (β)	Standard Error	P-value
Intercept	-0.3170	0.7226	0.66087
Age			
Age1	1.2547	0.3800	0.000962
Age2	1.5729	0.4408	0.000359
Child's sex	-0.2335	0.2147	0.276807
Child's weight			
Weight1	-1.3464	0.3876	0.000513
Weight2	-1.2554	0.3859	0.001141
Child's length			
length1	-0.0309	0.6075	0.959401
length2	-0.1954	0.6613	0.767583
Child's Hd. Circ.	0.2625	0.2451	0.284241

AIC: 518.83

Table 3: Probit regression coefficients, standard errors and p-values

	Estimate	Standard Error	P-value
Intercept	-0.1959	0.4363	0.6534
Age			
Age1	0.7598	0.2166	0.0005
Age2	0.9523	0.2572	0.0002
Child's sex	-0.1524	0.1316	0.2468
Child's weight			
weight1	-0.8298	0.2343	0.0004
weight2	-0.7646	0.2331	0.0010
Child's length			
length1	-0.0074	0.3717	0.9840
length2	-0.1040	0.4049	0.7973
Child's Hd. Circ.	0.1590	0.1505	0.2909

AIC: 518.64

Discussion

Tables 2 and 3 present the results of binomial logistic and probit regression models coefficients, standard errors and p-values. From the two tables, Maternal age1, Maternal age2 and head circumference have positive coefficients while sex, Child's weight1, Child's weight2, Child's lenght1, Child's lenght2 have negative coefficients. A unit increases in the factors with positive coefficients increase the chance of having CS while a unit increase in the factors with negative coefficients decrease the chance of having CS. The AIC of Binomial Logistic Regression is 518.83 and AIC of probit regression is 518.64. The two models produce almost the same goodness of fit but with different parameter estimates. Hence, the Probit regression model with the lowest AIC is more

preferable and will be used to identify the factors affecting mode of delivery.

In Table 3, the intercept gives the estimated mean probability of having CS holding other independent variables constant at the reference points as 0.196. The coefficient of maternal age between 25 and 35 years of age is 0.76 which is significant at 5% significant level. This means that the movement from age less than 25 years to age 25-35years produced 76% point change in the probability of delivery through CS. The coefficient of maternal age greater than 35 years of age is 0.95 which is significant at 5% significant level. This means that the movement from age less than 25 years to age 35years and above produced 95% point change in the probability of delivery through CS. The movement from maternal age 25-35 years to maternal age 35 years and above increases the chance of having CS by 19% (95% - 76%).

The coefficient of child's sex is -0.1524, that is, the probability of having a female child through CS is less than that of male child by 15.24% but not significant at 5% significant level. The coefficient of child's weight1 and child'sweight2 are significant at 5% significant level which means that there is CS child's weight gap in the target population. Child's weight between 2.6-3.0 kg have 83% change point lower probability of being delivered through CS than those that are less than 2.6 kg while Child's weight greater than 3.0 kg have 76.5% change point lower probability of being delivered through CS than those that are less than 2.6 kg. The coefficient Child's lenght1 and Child's length2 are -0.0074 and -0.1040 respectively. The coefficients are not significant at 5% level of significance, that is, there is no CS Child's length gap in the target population. The child's length between 40cm-49cm and child's length greater than 49cm are slightly less likely to deliver via CS than those whose length are less than 40cm. The coefficient of child's head circumference is 0.1590 which is not significant at 5% level of significance. The probability that a child with head circumference greater than 35cm is larger than those whose head circumference are between 20-35cm, that is, a child with head circumference greater than 35cm are more likely to deliver via CS than those that are between 20-35cm.

The results showed that mother's age at birth and child's weight has significant effects on the probability of having a child through CS. That means there is maternal age and child's weight CS gap in the target population. Also, children with head circumference greater than 35cm are more likely to deliver via CS than those that are between 20-35cm, though not significant. Child's sex and child's length have no significant effects on the probability of having a child through CS.

CONCLUSION

Childbirth, which can either be through caesarean section or normal delivery, is a special phenomenon in the life of women. This research work investigated some of the factors affecting mode of delivery using dummy dependent regression models. Binomial logistic and probit Regression models were fitted into the data collected from State Hospital, Ota on mode of delivery. The probit Regression model with the lowest AIC was used to identify prognostic factors affecting mode of delivery. The result showed that maternal age and child's weight has significant effects on the probability of having a child through CS. Also, children with head circumference greater than 35 cm are more likely to be delivered via CS than those that are between 20-35 cm. The result revealed strong associations between weight of the baby and age of the mother at birth. Hence, maternal age, child's weight and child's head circumference are important predictors for CS delivery.

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