Semi Parametric Analysis of Neonatal Mortality Caused By Jaundice

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Abstract: Despite many articles publication on neonates jaundice by statisticians and social scientists on behavioural effects of the epidemic as well as its effects on families, communities and the nation at large, priors' information on effects of its determinants remain unexplained. This paper investigates the linear and nonlinear(spline)effects of determinants of neonate jaundice among neonates babies between 2005 and 2010 in the University of teaching hospital, Ibadan. A total of 232 neonates jaundice cases from medical records units of the hospital were collected and categorized into mild and severe jaundice with which it is showed that gender of baby, mode of delivery, place of delivery, gestation-age, mother education, mother health and G6DP as major factors increase survival chance of neonates with jaundicewhile parity, rhesus factor and jaundice reduce it. The result also shows that new born babies within 1-5 days of birth are at higher risk of dying compared 6 days old and above with slightly low likelihood of it. Also, days spent in hospital increases the survival chance of neonate babies suffering jaundice.Effective and sustained health education of the pregnant women for early booking for ANC and delivery in appropriate health centres, as well as prompt presentation of affected newborn for appropriate medical care should be implemented to prevent this unacceptable health situation.

Key words: prior information, spline effect, neonates, jaundice, UCH.

1. Introduction

Neonatal jaundice is a very common health condition worldwide, occurring in up to 60% of term and 80% of preterm new born in the first week of life (Wang et al. (2005). Extreme hyperbilirubinaemia which is a common cause of neonatal morbidity and mortality in developing but uncommon in developed countries often results in kernicterus with its resultant burden, such as medical, economic and social, on the patient family and society at large (Slusher et al 2009) Yearly, one hundred and thirty five (135) million newborns enter the world with probabilities of surviving and thriving vary dramatically depending on which world these babies are born into, from high-income countries with universal neonatal intensive care to the world of home births without midwives, medical supplies, or health system support (Howson et al 2012).White (2013) worked on four (4) survival analysis models to evaluate differences in Length of stay based on Phototherapy treatment and concluded that infants who received Phototherapy had significantly longer Length of Stay than untreated infants. The results of the stratified analysis suggest that Phototherapy does not differentially affect respective hazard ratios on the basis of socio demographic factors. The survival analysis carried out showed that hazard regression models used to adjust for strong predictors such as receipts of breastfeeding, being exchange transfusion, high direct bilirubin was independently associated with higher and faster mortality(Manju et al.(2004).In support of the importance of breastfeeding in first week of birth, it was reported that there is a positive correlation between patients with a total serum bilirubin concentration and supplementary feeding; oppositely, breastfed neonates did not present a higher frequency of significant hyperbilirubinemia in the first day of life(Giovanna et al.2001). From a report it was

revealed that feto- maternal blood group incompatibilities, G6PD deficiency and infections as well as effects of negative traditional and social practices such as consumption of herbal medications in pregnancy, application of dusting powder on baby, use of camphor balls to store babies clothes are the major causes of severe neonatal jaundice in the developing countries(Owa and Ogunlesi 2009).Also, Folorunso et al. (2015) concluded that Term neonates are at lower risk than preterm neonates and Rhesus compatibility are at lower risk than neonates with Rhesus incompatibility.

2. Material and Methods

2.1 Data Description

This is a retrospective study in which data was retrieved from neonate's case note at children outpatients (CHOP) units of the University College Hospital, Ibadan and the data spanned through 2005 to 2010. The variables that were considered are as follows age, sex, gestational age, mother illness, mother education, mode and place of delivery, parity, settlement, Rhesus factor, G6PD and jaundiced neonate which forms part of the predictor variables. Considering the data used, the survival of the jaundice neonates were used as the response variable that is when a jaundice neonate is alive or dead.

2.2 Methodology

Generalised linear model assume that, given covariate vector (x) and unknown parameters β, the distribution of the response variable y belongs to an exponential family(Fahrmeir and Tutz, 2001) with mean $\mu = E(y/x$,β) linked to linear predictor by

$$\mu = h(\eta)\mu = h(x'\beta) \quad (1)$$

where h is a known response function and β_i are unknown regression parametersTo overcome the problem of assumption of a linear effect of continuous covariate of the predictor, the structured additive predictor,

$\eta = f(x) + \gamma'\beta$ (2)

proposedby (Kneib and Fahrmeir 2006 and 2007) was introduced. The $f(x)$ is a nonlinear(unknown) smooth function of the metrical covariate.

let$Y_{ij}$and π_{ij} be the baby suffering from jaundice and probability of neonatal mortality j,j=1..n_i in area(residence) i=1,..,s The effect of the risk factors on the baseline intensity function for subject ij attime *t* is given by the Cox proportional hazards model

$$\lambda_i(t)=\exp\left(\eta_i(t)\right) \quad (3)$$

$$\text{With } \eta_i(t)=f_o(t)+ f_i\left(x_{ij}\right) + \gamma_i{}' \beta \quad (4)$$

where $f_0(t)=\log\lambda_0\ \left(t_{ij}\right)$suppressing the index ($ijg$), is the log-baseline effect, f_j is the nonlinear function of a continuous covariatex_j, with Penalizes Spline with Random Walk of order one(psplinerw1) priors for babies days old and $\gamma$the vector of the linear fixed effects.

3. Analysis and Result

Baseline effect

The estimated nonlinear effect of days spent on admission by jaundice babies (baseline time) modeled and fitted through Bayesian P-splines are shown in Fig.2. The posterior modes are presented within 80–95 % credible intervals, and show that the baseline effect started from a

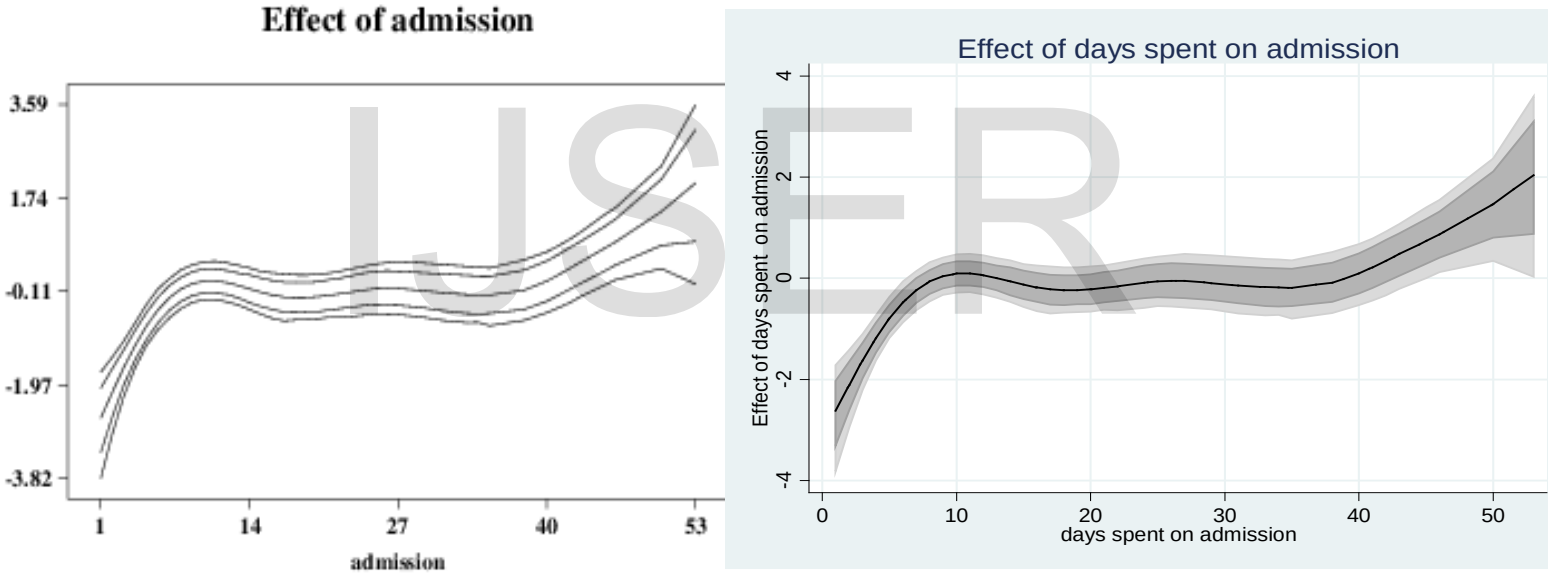
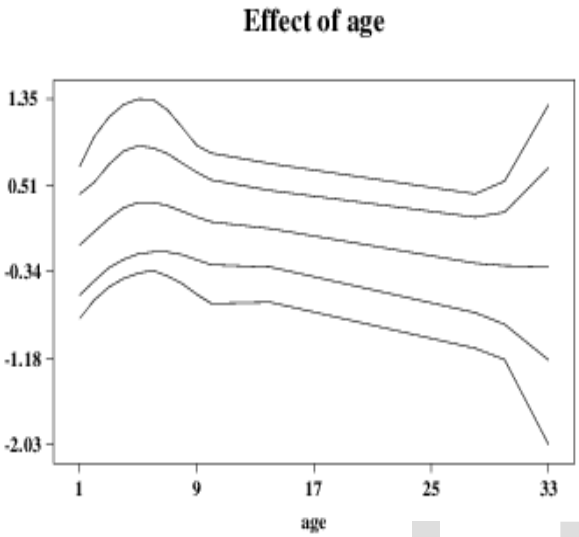


Fig. 2 Estimated non linear effect of baseline time(days) shown in the credible interval

comparablyfast to increase from 1- 10 days spent in the hospital, steady from 10 days until 40 days in this hospital before started raising again. This implies that the likelihood of neonates babies surviving from jaundice was very fast increasing in the first two weeks of birth before it started steadily but slowly increasing perhaps because of continuous medical attention and visit by health workers.

Non linear effect

Turning attention to the estimated nonlinear effect of days old of baby at the birth through penalized spline with random order 2, the result presented in the Fig.2 and b show that there is a steady decline in neonatal mortality from 5 and above. This shows a remarkable effort of



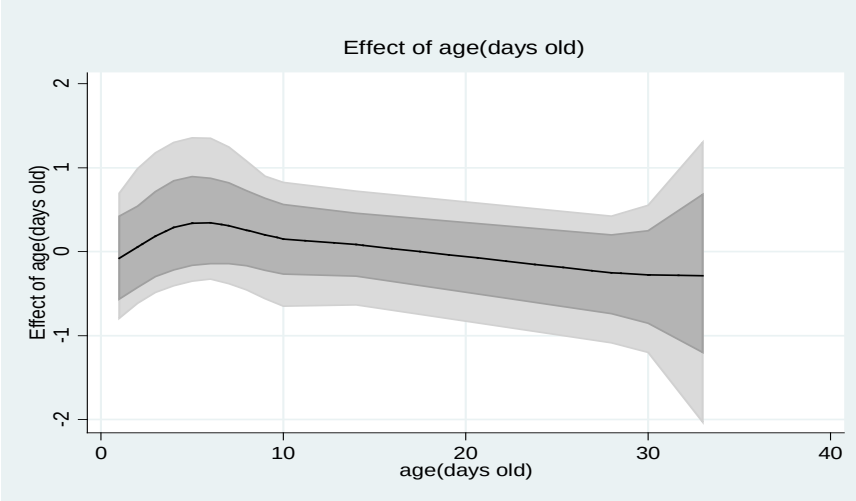


Fig.2 Estimated nonlinear effect of days of babies at birth shown in the 80-95% posterior mode of credible interval of babies at birth which is promptly attended to when jaundice is noticed.

health workers at place of delivery and heath condition of the babies. Prompt medical attention to babies suffering from jaundice with available medical facilities enhances the chance of babies surviving from this health challenge.

Table 1 **Posterior Estimates of Fixed Effects of Neonatal Mortality**

Covariates	Post. Mean	Std. Dev.	Credible Interval	
gender of baby	0.4348	0.2037	0.0209	0.8354
mode of delivery	0.0974	0.1794	-0.2575	0.4444
place of delivery	0.7949	0.2980	0.2308	1.3795
parity	-0.0606	0.0583	-0.1741	0.0552
gestage	0.3844	0.1730	0.0419	0.7206
rhesus factor	-0.0541	0.1885	-0.4292	0.3178
mother education	0.2235	0.1896	-0.1314	0.6094
mother health	0.6921	0.3066	0.0985	1.3026

g6dp	0.3967	0.2261	-0.0331	0.8340
jaundice	-0.3227	0.1926	-0.7045	0.0513

Theresult obtained from the Tab.1 shows that gender of baby, mode of delivery, place of delivery, gestational age,mother education, mother illness, G6PD, positively significantto the survival chances of neonates suffering from jaundice; on the contrary parity, rhesus factor and jaundice negatively significantly contribute to it.

4. Discussion of Result

It is apparent noticeable in the graphs that after controlling for the non linear effect in the data, all the considered covariates in this work associated with neonatal mortality in the fixed part of the model were found to haveeffects in the expected directions. A remarkable finding however, is that 1- 5 days old babies thatspent 1-10 days on admission are at slightly increasing risk of dying, above 6 days old babies that spent 11- 43 days on admission are relatively steady before it rises again. This may not be unconnected with factors that might contribute to neonatal deaths such as the good place of delivery.

Results of this study show a high risk of neonatal mortality associated with jaundice within 1- 5days of birth and that nonlinear effects of age(days old) and days spent in hospital are in the expected direction, emphasizing the risk associated with jaundice, especially the higher risk associated with babies from 1-5. The posterior estimates for neonatal mortality in Tab.1show identified risk factors that positively and negatively significantly contributedto survival chances of babies.

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