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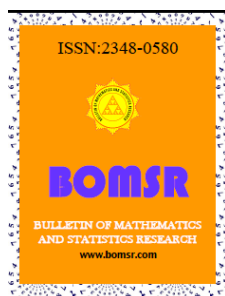
Effect of socio-demographic factors on first antenatal checkups in first trimester using analysis of Binary Logistic Regression Model

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ABSTRACT

Antenatal care in initial stage of pregnancy must be minimise the risk of both mother and child. Based on surveyed 367 women, only 59.9% had taken ANC in first trimester. The logistic regression analysis model resulted that women's education were found important predictors for taking antenatal checkups in first trimester while birth order moderately. Women with 5 years schooling were more likely (OR=1.213,CI; 0.608 to 2.420) to use antenatal checkups as compared to illiterate women. Women who have schooling 8 years and more were significantly prefer (OR=3.636,CI; 1.418 to 9.323; p<0.007) to use ANC services comparison to illiterate as well as women educated up to primary level. Women education and previous exposure of pregnancy on MCH services were found impact to utilise ANC services in first trimester of pregnancy. The IEC campaign in the form of culturally supported and implementation strategy in harmony can empower to women and force to go hospital for proper ANC care.

Keywords: Antenatal care, Logistic regression analysis, Vulnerable population, Tribal group, India

Introduction

Fundamental approaches for the statistical modelling, regression analysis is an statistical techniques for estimating the relationships between a dependent variable and one or more nominal, ordinal, interval or ratio-level covariates as predictors in the regression test statistics. Logistic regression is the appropriate regression analysis for the prediction when the dependent variable is dichotomous (binary) form in nature. Some important assumptions needed as the

outcome (dependent variable) must be discrete (dichotomous in nature) for e.g., presence vs. absent. No outliers in the data, which can be assessed converting the continuous predictors can be assessed by a correlation matrix among the predictors. So for the purpose of prediction considered outcome variable (Timing of first ANC checkups in first trimester) is a stochastic event. We analyze a ANC checkups rate, the outcome event is either taken ANC in first trimester or not taken in first trimester. Events occurs only these two states, logistic regression thinks in likelihoods of the ANC checkups. From time to time instead of a logit model for logistic regression a probit model is used. Generally, a model is fitted with both functions models and the function with the better fit is chosen. However, probit assumes normal distribution of the probability of the event, when logit assumes the log distribution. Use of health care services is a complex behavioural phenomenon. The characteristics in relation to availability and feasibility of health services revealed force for preventive and curative as well as social structure and health believe also. The purpose of this article is to examine the factors that influence the use of ANC services at initial stage of pregnancy within three month of pregnancy(first trimester) in disadvantage population in Madhya Pradesh. For the purpose to examine the responsible factors which affecting to avail antenatal care in initial stage of pregnancy. Hence need to analyse the data using the logistic regression technique for appropriate prediction. The research data were collected in 2015-16 on maternal health care to determine the use of services among Baiga primitive tribal population in Dindori district in Madhya Pradesh. They are inhabits in dense hilly forest area and tattooing is an integral part of their lifestyle of women[1]. For look into the matter of maternal & child health care, antenatal care is an imperative predictor of safe delivery and provides health in sequence and services that can improve the health of women and infants[2,3].The importance of using maternal health care services during pregnancy facilitated in reducing maternal mortality and morbidity has established a significant recognition. The background characteristics of this tribes on the issues have low awareness and underutilization of maternal health care services[4]. So for it is opportunity to see the level and determinants of antenatal care particularly in first trimester and its health impact on women and her child. The article aimed to predict the valuable factors which effects for improving the antenatal care services.

Materials and Methods

A survey on maternal health care was carried out in Dindori district of Madhya Pradesh state in central India during the period 2015 to 2016. Of 367 currently married women who had experienced maternity during last five years identified for antenatal care practices. The data were collected by conducting interview with women by trained field investigator after obtaining informed written consent.

1. Study population, sample and variables: A survey was carried out in 24 villages in the district Dindori of Madhya Pradesh during 2015 to 2016. All individual of Baiga population 2258 of 460 households were surveyed with probability proportion to size (PPS) sampling procedure. Of them, 367 women who had experienced maternity during last five year were interviewed on the ANC care. This tribe have poor socio-economic profile with majority of living standard in nuclear family, occupied in labour/agricultural work, low literacy, no separate kitchen for cooking, etc. The distribution of 367 currently married women in reproductive age (15-49 years) interviewed, classified by level of education, previous birth order and antenatal care use. In our analysis of these data the timing of first ANC checkups in first trimester (up to 3 month of pregnancy) considered response variable of interest and women education, previous birth order as predictors. Note that response has two categories as use and non-use the services. in this analysis all predictors are tested as categorical variables. The survey included information on the highest level of education, but here classified into three simple distinction as illiterate, primary, middle school or more. Similarly, the

previous birth order measured as 0-1, 2-4 and 5 or more births. The basic aim of the analysis is to describe the way in which first ANC use in first trimester varies by education and previous birth orders. This is an example of the type of research question that we have considered extend to which the association between education and ANC use is affected by the fact that women with illiterate, primary or higher education.

It is the introducing concept of logistic regression to compute odds ratio using SPSS-version-20 to see the factor associated with first ANC checkups in first trimester among tribal women in rural area. Hence the defining the variables for the model,

Dependent or outcome variable

Timing of first ANC checkups in first trimester

- ▪ Measured; Yes/No
- ▪ Type; binary

Independent or Covariates variables

1. Women education

- • Measured;   Illiterate / Primary / Middle+
- • Type; Categorical

2. Previous birth order

- ▪ Measured;   0-1 / 2-4 / 5^+
- ▪ Type; Categorical

2. Technique of statistical modelling: On the basis of the structure of outcome and explanatory variables needs to take up the statistical analysis as Binary Logistic Regression: For the appropriate analysis first need to defined the concept of binomial distribution.

The Binomial Distribution:

We consider the response variable is *Yi* is binary, assuming only two values coded one or zero.

$$Yi = \begin{cases} 1 \text{ if the i-th women is using ANC} \\ \\ 0 \text{ otherwise} \end{cases} \tag{1}$$

Values one and zero with probabilities π_i & $1 - \pi_i$, respectively.

Its converted in the model in the form of logistic[5].

The Logistic Model:

The functional expression of *Dependent Variable* can be written as

$$Y = \begin{cases} 1, \text{ if the event occurs} \\ \\ 0, \text{ if no event} \end{cases} \tag{2}$$

In binomial terminology, the probability of ANC checkups in first trimester Model

$$\Pr(Y =1|X) = \exp (\alpha + \beta X)/ 1 + \exp (\alpha + \beta X) \tag{3}$$

Where X is one of the independent variable

Logistic model of First ANC in first trimester (FAFT)

$$Y = \begin{cases} 1, \text{ if the event occurs (FAFT), Case} \\ \\ 0, \text{ if no event (no FAFT), control} \end{cases} \tag{4}$$

The functional expression of *Independent Variable* can be written as

X is women education (yes/no)

$$X = \begin{cases} 1, \text{ if the subject has educated women} \\ \\ 0, \text{ if subject do not have educated women} \end{cases} \tag{5}$$

Probability of FAFT for given women education is 'p' therefore,

p = Pr(Y =1|X) = exp (α + β * women education) / 1 + exp (α + β * women
              education)   (6)

Probability of no FAFT for given women education is '1-p' therefore,

1-p = Pr(Y =1|X) = 1- [exp (α + β * women education) / 1 + exp (α + β * women
 education)]

      = 1 / 1 + exp (α + β * women   education)   (7)

Measure the probability of association between event occurred in case & control

by the ratio of these two odds; equation (6) / (7);

p / 1-p = exp (α + β * women education)

p / 1-p = Odds ratio = exp (α + β * women education)

p / 1-p = Odds ratio = exp (α + βX)

      $\ln(p / 1\text{-}p) = α + β$ * women education= Ln (Odds)=LOGIT Model   (8)

Where α is the location and β is the slope[6].

For Binary/Dichotomous of X

$X = \begin{cases} 1, \text{ if exposed} \\ \\ 0, \text{ if unexposed} \end{cases}$ (9)

For Exposed, the log Odds of FAFT is

      $\ln(p_1 / 1\text{-}p_1)= α + βX = α + β * 1 = α + β$ (10)

For Unexposed the log Odds of FAFT is

      $\ln(p_0 / 1\text{-}p_0)= α + βX = α + β * 0 = α$ (11)

Therefore, the measurements of regression in terms of odds ratio

Odds Ratio(OR) = (log Odds of FAFT in the exposed) / (log Odds of FAFT in the
   unexposed)   (12)

                  $= \ln (p_1 / 1\text{-}p_1) / \ln(p_0 / 1\text{-}p_0)]$

                  $= \ln \{(p_1 / 1\text{-}p_1) - (p_0 / 1\text{-}p_0)\}$

                  $= (α + β) - α$

                  $= β$

                   ie; ln (Odds Ratio) = β

                   Odds Ratio = $e^β$ (13)

The regression parameter from logistic regression can be interpreted in terms of
In OR for ANC, hence

                  In OR = Log Odds Ratio= Regression Coefficients (β)   (14)

Therefore, the basic functional equation form of binary logistic regression model is;

 Log(p / 1-p)= $b_0+b_1x_1+b_2x_2+b_3x_3+ ....+b_kx_k$.   (15)

Where p is the estimated probability of any measures of service utilization, b_0 is constant,
$b_1,b_2,b_3,.....b_k$ are the coefficients of independent variables (covariates) $x_1,x_2,x_3, ...x_k$.

Results

1. Women characteristics and use of ANC services: The study was carried out in all selected 24
villages from three tribal blocks. A total population 2548 through 556 households were covered. A
significant proportion (more than 70%) of the women were illiterate. About 62% of the women was
in higher parity (birth order) with 2 to 4 child. Out of 367 samples of women, 302(82.3%) women
were taken ANC checkups and of them 181(59.9%) start obtaining the services in first trimester.

Table 1: Percent distribution of women characteristics as explanatory & outcome variables

Variable/ Individual characteristics	Number of women (n =367)	Marginal Percent	95% Confidence Interval of Marginal Percent
Women's education ▪ Illiterate ▪ Primary ▪ Middle[+]	270 35 62 N=367	73.6 9.5 16.9 100.0	68.8, 78.4 6.5, 12.5 13.1, 20.7
Previous birth order ▪ 0-1 ▪ 2-4 ▪ 5+	122 227 18 N=367	33.2 61.9 4.9 100.0	28.4, 38.0 56.9, 66.9 2.7, 7.1
ANC taken ▪ Yes ▪ No	302 65 N=367	82.3 17.7 100.0	78.5, 86.1 13.9, 21.5
Timing of first ANC checkups ▪ In first trimester ▪ After first trimester	181 121 N=302	59.9 40.1 100.0	54.3, 65.5 34.5, 45.7

2. Correlation matrix for ANC use model: The outcome variable which coded as 0 and 1 and it is placed in the analysis labelled as Dependent, while all predictors are entered into the Covariates interval level covariates appropriately dummy coded. The results of the use of ANC model expressed in the form of correlation matrix in table-2. Level of correlation between primary and middle+ education were found 0.573 along with birth order 2 to 4 and 5+ were at 0.872 correlated.

Table-2: Results of correlation matrix

Correlation Matrix					
	Constant	Primary School	Middle School[+]	Birth order (2-4)	Birth order (5[+])
Constant	1.000	-.500	-.316	-.830	-.824
Primary School	-.500	1.000	.573	.098	-.015
Middle School[+]	-.316	.573	1.000	-.030	-.019
Birth order(2-4)	-.830	.098	-.030	1.000	.872
Birth order(5[+])	-.824	-.015	-.019	.872	1.000

3. Logistic regression model for ANC: For the prediction and interpretation, Logistic Regression analysis model were run for the results in terms to measure the effect of socio-demographic variables as women education and exposure of previous pregnancy on reported particular uses of ANC services during first trimester of pregnancy. The significant was considered with 5% level of probability found less than *(p<0.05)*. Women's education were found important predictors of receiving antenatal checkups in first trimester while birth order moderately (Table-3). Women with 5 years schooling were more likely (OR=1.213,CI; 0.608 to 2.420) to use antenatal checkups as

compared to illiterate women. Women who have schooling 8 years and more were significantly have a preference (OR=3.636,CI; 1.418 to 9.323; p<0.007) to use ANC services comparison to illiterate as well as women educated up to primary level. Among women who were experiences of 2 to 4 births liking lower 40% use of ANC services in during the initial stage of pregnancy compare to women who have exposure of pregnancy 0 to 1. The high parity of women (5 and more births) associated higher (94%) use of ANC services in comparison to low parity of women.

4. Fitting models to data

From Table- 3, the fitted model is;

Logit (p) = -0.371+ (0.193 x women education upto primary) + (1.291 x women education middle$^+$) + (-0.908 x Birth order 2 to 4) + (-0.063 x Birth order 5 to more) / 1+ -0.371+ (0.193 x women education upto primary) + (1.291 x women education middle$^+$) + (-0.908 x Birth order 2 to 4) + (-0.063 x Birth order 5 to more)

Or Predictive probability can be calculated as

p= e$^{-0.371+ (0.193 \times \text{women education upto primary}) + (1.291 \times \text{women education middle+}) + (-0.908 \times \text{Birth order 2 to 4}) + (-0.063 \times \text{Birth order 5 to more})}$

/ 1+ e$^{-0.371+ (0.193 \times \text{women education upto primary}) + (1.291 \times \text{women education middle+}) + (-0.908 \times \text{Birth order 2 to 4}) + (-0.063 \times \text{Birth order 5 to more})}$

Table-3: Estimates of the logistic regression model

Variables in the Equation								
Variables of women characteristics	β	S.E.	Wald	d.f	Sig.	Exp(β)	95% C.I. for EXP(β)	
							Lower	Upper
▪ Women Education								
Illiterate ^{R}			8.694	2	.013			
Primary School	.193	.352	.299	1	.584	1.213	.608	2.420
Middle School$^+$	1.291	.480	7.222	1	.007	3.636	1.418	9.323
▪ Exposure of pregnancy								
Birth order (0-1) ^{R}			9.085	2	.011			
Birth order(2-4)	-.908	.576	2.482	1	.115	.403	.130	1.248
Birth order(5$^+$)	-.063	.543	.013	1	.908	.939	.324	2.723
Constant	-.371	.604	.377	1	.539	.690		

Discussion

The Hosmer-Lemeshow test results (X^2= 2.794, 4 degree of freedom, P=0.593) indicate that the goodness of fit is satisfactory. However, the Nagelkerke R^2 value was 0.077 suggesting that the model is not very useful in predicting ANC use in first trimester. Although the contribution of the two explanatory variables in the prediction of first ANC use in first trimester of pregnancy for educated women is statistically significant (P=0.007) with the effect size is large. The area under the ROC curve for these data gave a predicted probability value of 0.38% , indicating that the no discrimination. It is well recognized that mothers education has a positive impact on health care utilization. Findings of the study found that the women education have quantitatively importance and statistically significant effect on the use of ANC services. In a study in Peru found statistically significant effects of mothers education on use of prenatal care and delivery assistant[7]. It is argued that educated women are more aware of health problems and know more about the availability and feasibility of health care services. Another study also found mothers education to be the most consistent and important determinants of the use of maternal and child health care services[8]. Exposure of previous

pregnancy is also an important factors for the use of ANC services during pregnancy. The estimates of the logistic regression model originate that about 40% use of ANC services among who have exposed 2 to 4 births and about 94% use of services in the case of the exposure of 5^+ births comparison to no birth or least exposure of pregnancy. The literature support that the several studies found a strong association between birth order and use of ANC services[9,7].

Ailing healthcare were exist in the community except who have educated preferring the health care and understand. A better option would have been to hardness poor family in forest area who have out of pocket private expenditure funds through social insurance mechanism need to develop. The health system is a doctor-centric model but in the tribal areas health providers have been observed thinned. Although India has a double burden of both infectious (tuberculosis, malaria) and non-communicable disease(diabetes, cancer and heart disease).The increasing life expectancy brings complex and long drawn illnesses that entail skilled care, technology and costs. A major problem is the declining quality and affordability of medical education and the paucity of trained nurses and paramedics. It might to develop strategic purchasing of private care for poor family/underserved areas through public private partnerships (PPPs) for the managements of determinants and control/elimination of communicable and non-communicable disease. A rights based approach entails the State to provide all the way, which is detrimental to the State, the peoples and the health sectors itself. National Health Policy (NHP-2017) takes a pragmatic middle way for essential primary care and averting catastrophic expenditures rather than force another conflict on 'denial to rights'. The Indian health system also faces the problem of child and maternal mortality and malnutrition in both childhood and adult life along with low utilization of health care facility in rural-tribal area. On the basis of findings of this study leads to predict that the all pregnant mother should use the pregnancy care from the initial stage of pregnancy (first trimester) under the assumptions; (i) If each mother educated on the risk of pregnancy and its solution/benefits just after marriage- adequate antenatal care; essential 4 ANCs checkups during the pregnancy inclusion of first ANC checkups in first trimester, (ii) If each family improved standard of living through socioeconomic status with the better education facility and employments. After fulfilling the criteria of assumption they would able to better understand about health care and for making adequate decision to within time lived.

Conclusion

The health impact of antenatal care is besides depends on when women initiate obtaining antenatal care during pregnancy. About 302(82.3%) women taken antenatal care during pregnancy and out of them 181(59.9%) women were taken first antenatal checkups in first trimester. Women's education were found significant (p<0.05) impact on timing of antenatal visit in first trimester while exposure of previous pregnancy have a mild effect to force for taking ANC care during the first trimester of pregnancy in study population. The strong influence of mother education on the use of health care services is consistent with the findings from other studies. Proper use of ANC services may excessively affects the good quality of health among most backward vulnerable population. Intended for develop their confidence, skill and solving health difficulties during pregnancy through availing maternal health care services since initial stage of pregnancy. So for efficient and effective health education programme need to design specially to the illiterate segment of population for spreading awareness on the issues among them through proper implementation.

Acknowledgements

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