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EFFECTS OF PRENATAL ALCOHOL AND SMOKING EXPOSURE ON CHILDREN IQ DEVELOPMENT

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Abstract

Background: Maternal smoking and alcohol exposure in pregnancy lowers BMI and affects the child IQ.

Method: A cross sectional study in which we explored the IQ of school going children in the age group (11-17) and analyzes the factors associated with prenatal exposure of father and mother with the help of designed questionnaire and develop Ordinal logistic regression model.. Intelligence Quotient Score by Dr. P. Shrinivasan verbal intelligence test collected in pre-designed questionnaire in the class room without the presence of school administration so that student feel free in the class room to fill the information given in the questionnaire explained by the researcher.

Result: In this study we observed that the mother whose education qualification was 12^{th} pass have highest rate of non smoker category 93% and mother whose education qualification was Matric have highest rate of smoking during pregnancy 9.6%. Mother who smokes during pregnancy was found 10.5 % and 4.6% in urban and rural area. And mother who smoke during pregnancy gave birth to a child in preterm category and full term was 10% and 6.8%. We found there is significant association between children IQ and maternal smoking habit during pregnancy $p=0.049$. This indicates that maternal smoking habit during pregnancy negatively affects the IQ level of children. In an ordinal logistic regression table we found that these variables namely Alcohol intake of father, smoking habit of father, chewing habit of father, mother smoking during pregnancy, alcohol intake of mother, chewing habit of mother, health status of mother and type of delivery were significantly associated ($p<0.05$), thus we conclude that these variables of prenatal exposure affect the IQ level of children.

Conclusion: In our study we used chi-square test and ordinal logistic regression to check the association between children IQ and maternal smoking habit, prenatal exposure of father and mother. Smoking during pregnancy is likely to be one of the factors that affect the IQ of children. We conclude that there is significant association between children IQ and maternal smoking habit by using chi square test and when we apply ordinal logistic regression, we conclude that the IQ of children is affected by the prenatal exposure of father and mother.

Keywords: Fetal Alcohol Syndorom disorder, Prenatal exposure, children IQ

Chapter-4

Effects of Prenatal Alcohol and Smoking Exposure on Children IQ development

INTRODUCTION

Maternal smoking during pregnancy has been associated with a wide range of adverse outcomes in offspring (Royal college of Physicians, 1992 and Olds, 1997). Women who smoke are also likely to drink alcohol. The most serious affect of maternal smoking and drinking during pregnancy is fetal alcohol syndrome (FAS). FAS was first described in the United States (Jones et al., 1973), who identified a distinctive set of facial anomalies-short eyelid openings, flat mid-face, thin upper lip, and a flat or smooth groove between nose and upper lip (philtrum)-in children whose mothers drank very heavily during pregnancy. These children also exhibit growth retardation as well as significant cognitive and behavioural problems. The term "fetal alcohol effects" (FAE) is applied to children whose mothers are known to have drunk heavily during pregnancy and who exhibit some, but not all, of the characteristics of FAS (Streissguth et al., 1991 & Coles et al., 1997). The IQ scores of FAE patients are also depressed but tend to be somewhat higher than those found in FAS children. Research examining effects of alcohol on the developing brain has documented a broad range of cognitive and behavioural deficits in children with fetal alcohol spectrum disorders (FASD), including IQ and attention deficits; poor learning, memory and impaired executive function (Mattson et al., 2011). Social and behavioural problems have also been reported in children with FASD. In one study adaptive behaviour scores in children with fetal alcohol syndrome exceeded what could be explained by low IQ scores (Thomas et al., 1998).

In another study, parents reported more social, delinquent, and aggressive behaviours in alcohol-exposed children and controls (Mattson et al., 2000). Similarly, teachers reported more problems in these domains in children with prenatal alcohol exposure (PAE) at 7.5 and 14 years (Jacobson et al., 2006; Dodge et al., 2014). In the study performed in United States (Pittsburgh, Pennsylvania) moderate alcohol exposure during the 1st and 2nd trimesters was related to the poorer composite score for African American children at age of 10 years. Significant relations were also found for the verbal, abstract/visual, and quantitative subscales (Willford et al., 2006). The larger amount of studies evaluating the impact of prenatal exposure to active maternal smoking on cognitive development, intelligence and intellectual impairment focused on older children including preschool children and adolescents (Batty et al., 2006; Lawlor et al., 2006; Gilman, 2008; Braun et al., 2009; Kafouri et al., 2009 & O Callaghan et al., 2010).

Although alcohol and tobacco are frequently used together during pregnancy, researchers studying the negative effects of prenatal exposure to tobacco and alcohol have generally examined the effects of each drug separately. But this article is focused on determining the effects of prenatal exposure to tobacco and alcohol on the cognitive ability and intelligence quotient of school going children.

Methodology

Study Design

A cross-sectional study was designed to estimate the factors affecting the intelligence quotient of school going children in Jammu division. This study includes the middle school students of class (8^{th}) from urban and rural areas, belonging to both gender studying in the Govt and the Non-Govt schools of Jammu division from the Jammu and Samba district.

Sample Size Determination

To determine the sample size, degree of freedom and margin of errors would be considered.

On the basis of previous study conducted by Daniza M.I. in 2002 reported that the prevalence of low IQ in non govt school was 11.5%. On the basis of this study we assumed the same prevalence of IQ and usual constant $\alpha = 0.05$, $\beta = 0.20$, power of study 80% and margin of error is 3%.

Now the sample size was determined using the formula for sample size determination for the population. This is

$$n = \frac{Z^2 p(1-p)}{d^2}$$

where, Z is the critical value at 95% confidence level of certainty is (1.96). p = probability of success, q = 1-p is the probability of failure. And power of study $(1-\beta) = 0.80$. Then,

$$n = \frac{(1.96)^2 0.885 \times 0.115}{(0.03)^2} = 434.420$$

This is rounded to 440 students from non-govt school and 440 students from Govt Schools. Finally, the required sample size for our study is approximately eight hundred eighty (880) students.

Sampling Procedure

In our study we apply multistage sampling technique and cluster sampling technique to select required number of sample. Eligible schools will be stratified into govt. and Non-Govt categories from rural and urban areas of Jammu district and Samba district of Jammu division. Then, required number of schools will be selected on the basis of probability proportional to sample size (PPS) i.e. the schools with high number of students are more likely to be selected than school with low number of students.

The study was carried out in the randomly selected 11 blocks from rural area and urban local bodies of two districts (Jammu and Samba) of Jammu division. To represent the rural sample we was randomly selected 22 villages from 11 blocks of two districts and make

list of schools. Then from the list of school we randomly selected 4 schools including Govt. School and Non-Govt. School equal in numbers affiliated to Jammu Kashmir Board of Secondary Education (JKBOSE) from each Block of two districts. Then from the each school 20 student including boys and girls will be selected from class 8th. The same procedure was followed for the selection of urban student from the Govt. schools and non-govt. schools by keeping the complete representation of whole area of selected 2 districts. This type of technique is very useful when the population compose of strata of different sizes so that representative sample must contain individual from each category stratum in accordance with size of sub-group.

Inclusion Criteria

- Children who are permanent / continuous residents of the areas are included.
- Children from all socioeconomic status were included.
- The schools with at least 10 students in class 8th will be eligible for the study.

Exclusion Criteria

- Children with birth defects, any form of neurological injury, injury to the brain or any systematic medical problem.
- Children with genetic disorder.

Ethical Clearance and Permission

The ethical clearance for the present study was obtained from the Head of the department. Written permission was sought from school offices. Before the study, prior information was sent to the principal and class teachers for the study.

Pre-Test

Pre-test of the questionnaire was conducted in one block by collecting a sample of 50 students which is not included in the selected sample and from all socio-economic characteristics with the people in the selected block. 50 subjects who fulfil the eligibility criteria were indentified and questionnaire was administered. By using Cronbach's alpha test the average of all correlation coefficient of the items within the test has value α=0.82. Then discussion is made on some confusion then both interviewers and supervisors could get clarity, understand ability and completeness of the questionnaire before the actual data collection task was commenced.

Data Collection and Method of Analysis

The background information of student was collected by personal interview and referring to the school registers. It includes name, age, gender, class, caste, occupation of parents, education of parents and family composition, type of house and socio-economic, personnel habits during registration period, health complaints ,low birth weight and blood pressure. Intelligence Quotient Score by Dr. P. Shrinivasan verbal intelligence test

conducted in pre-designed questionnaire in the class room without the presence of school administration so that student feel free in the class room to fill the information given in the questionnaire explained by the researcher.

The IQ level of students in urban and rural areas a lot of methods and tests were used. In our study we use the most appropriate and broadly used method to measure the IQ of children which was developed by Dr. P. Shrinivasan verbal intelligence test it's an Indian adaptation for scoring IQ of children in the age-group (11 to 17 yrs). Test results include a Full Scale IQ score as well as age-equivalent rankings and scores for Classification, Analogy, Assigning artificial values to arithmetical signs, reasoning.

To measure Intelligence Quotient (I.Q) our society has developed various means for the formal evaluation of intelligence. The term intelligence quotient generally describes score or grading on a test that rates the subject cognitive ability as compare to the general population.

Intelligence Quotient (IQ): Measure of intelligence that takes into account a child's mental and chronological age. IQ = $\frac{MA}{CA} \times 100$

where, MA is Mental age: the typical intelligence level found for people at a given chronological age and CA: Chronological age: the actual age of the child taking the intelligence test.

Intelligence quotient (IQ) is an age-related measure of intelligence level and is described as 100 times the mental age. The word 'quotient' means the result of dividing one quantity by another, and a definition of intelligence is mental ability or quickness of mind.

Intelligence quotient (IQ) is a standardized measure of human intellectual capacity that takes into account a wide range of cognitive skills. IQ is generally considered to be stable across the lifespan, with scores at one time point used to predict educational achievement and employment prospects in later years.

According to Dr. P. Shrinivasan verbal intelligence test there are four sub-test are

1) Classification

2) Analogy

3) Assigning artificial values to arithmetical signs

4) Reasoning"Intelligence means an innate ability to solve problems."Innate ability is that which is present in a person from birth and not learnt through self-study or as a result of class room instruction''.

The general classification of Intelligence score according to Dr P. Shrinivasan verbal intelligence test are represented in below mentioned table.

Dr P. Shrinivasan verbal Intelligence test classification

Classification	Range
Genius/Gifted	140 and above
Very Superior	125-139
Superior	110-124
Average	90-109
Borderline	75-89
Feebleminded	50-74
Imbecile	25-49
Idiot	0-24

To find the Prenatal exposure of father and mother we include 10 variable viz Alcohol habit of father, Smoking Habit of father, Chewing habit of Father, Heath status of father, Smoking Habit of mother, Alcohol habit of mother, Chewing Habit of mother, Heath Status of mother, Mode of delivery and type of delivery then we used ordinal logistic regression model in order to determine the risk factor i.e. Prenatal exposure of father and mother affect the IQ of school going children.

In an ordinal logistic regression model, the outcome variable is ordered, and has more than two levels. In our study, students 'IQ' is ordered from Superior to Feeble minded; children's proficiency in Intelligence is tested and scaled from 1 to 4. One appealing way of creating the ordinal variable is via categorization of an underlying continuous variable (Hosmer and Lemeshow, 2000).

Chi-Square Test

It was used to analysis the association between dependent and independent variables. Hypothesis testing:H_0: There was significant association between dependent variable and independent variables Vs H_1: Not H_0

To test the null hypothesis we can compare χ^2cal with χ^2tab is given by

$$\chi^2_{cal} = \sum_{i=1}^{n}\sum_{j=1}^{m}\frac{\left(O_{ij}-E_{ij}\right)^2}{E_{ij}} \qquad (i=1, 2 \ldots, n,\ j=1, 2 \ldots, m)$$

where, E_{ij} is expected frequency corresponding to $(ij)^{th}$ and O_{ij} be the observed frequency.

Odd ratio for ordinal data

Suppose the target response (Y) on quality of life has k ordered categories (Y_j with j=1,2....,k) and hat two groups (A and B) need to be compared. For the category j, OR is given by:

$$OR_j = \frac{\frac{P\left(\frac{Y\le Y_j}{x(A)}\right)}{1-P\left(\frac{Y\le Y_j}{x(A)}\right)}}{\frac{P\left(\frac{Y\le Y_j}{x(B)}\right)}{1-P\left(\frac{Y\le Y_j}{x(B)}\right)}} = \frac{\frac{P\left(\frac{Y\le Y_j}{x(A)}\right)}{P\left(\frac{Y<Y_j}{x(A)}\right)}}{\frac{P\left(\frac{Y\le Y_j}{x(B)}\right)}{P\left(\frac{Y>Y_j}{x(B)}\right)}} = \frac{odd^A}{odd^B} \quad (1)$$

According to the usual definition, OR is the ratio between two odds, but now odds is defined in term of cumulative probabilities. In the context of ordinal data, according to the proportional odds assumption, OR is the same for all categories of the response variable. (20)

General logistic Regression Model: In a binary logistic regression model, the response variable has two levels, with 1= success of the events, and 0=failure of the events. The probability of success is predicted on a set of predictors. The probability of success is predicted on a set of predictors. The logistic regression model can be expressed as:

$$\ln(Y') = \text{logit}[\pi(\underline{x})]$$
$$= \ln\left[\frac{\pi(\underline{x})}{1-\pi(\underline{x})}\right]$$
$$= \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots + \beta_P X_P \qquad (2)$$

SPSS Plum (Polychotomous Universal Model) is an extension of the generalised linear model for ordinal response data. It can provide five types of link functions including logit, probit, complementary log-log, cauchit and negative log-log. It takes the forms as follows:

$$\text{logit}[\pi(Y \le j|x_1, x_2, \ldots . x_p)] = \ln\left(\frac{\pi(Y \le j|x_1, x_2, \ldots . x_p)}{\pi(Y > j|x_1, x_2, \ldots . x_p)}\right)$$
$$= \alpha_j + (-\beta_1 X_1 - \beta_2 X_2 + \ldots\ldots - \beta_P X_P) \qquad (3)$$

where α_j's are the thresholds, and $\beta_1, \beta_2, \ldots \ldots \beta_p$ are logit coefficients; j=1,2.....j-1.

After calculation all the data were compiled and analyzed and appropriate Statistical tests were applied. Statistical analysis was accomplished using SPSS v. 20.

RESULT

In table 1 the socioeconomic characteristics of the total sample according to urban and rural area differently. We found total number of maternal whose type of delivery viz. preterm delivery was found 120 out 880 and full term delivery was 760 out of 880. Also we found this category of maternal type of delivery was categorized differently into urban and rural population was 66(55%) and 54(45%) in the preterm category and 414(54.5%) and 346(45.5%) in the full term delivery category. We also found mode of delivery of maternal viz. normal was 482 and caesarean category was 398 and these were categorized into urban area 482(53.9%) was and among rural area was 222(46.1%). Among 880 school going children we found 463 male children out of which 255(55.1%) male in urban and 208(44.9%) male in rural area and we found 417 female children out of which 225(54%) in urban and 192(46%) in rural area. Also we found the maternal education status among 880 sample categorized into five levels Illiterate, 8^{th}, 10^{th}, 12^{th}, Graduate and above among these category we found different level of percentage into urban and rural area which were shown in table no. 1. Also we found the maternal marriage age mean and standard deviation 21.88(2.81), 22.89(2.91) into urban and rural area.

Table 1: Characteristics of the study subjects in the Urban and Rural Area.

		Total (n=880)	Urban	Rural
Type of Delivery	Preterm Delivery (%)	120	66(55.0%)	54(45.0%)
	Fullterm Delivey (%)	760	414(54.5%)	346(45.5%)
Mode of Delivery	Normal (%)	482	482(53.9%)	222(46.1%)
	Caesarean (%)	398	220(55.3%)	178(44.7%)
Gender	Male	463	255(55.1%)	208(44.9%)
	Female	417	225(54.0%)	192(46.0%)
Mother Education	Illiterate	185	87(47.0%)	98(53.0%)
	8^{th}	358	195(54.5%)	163(45.5%)
	10^{th}	219	116(53.4%)	183(46.6%)
	12^{th}	75	52(69.3%)	23(30.7%)
	Graduate & above	43	29(67.4%)	14(32.6%)
Maternal Marriage Age(Mean & S.D)		880	21.88(2.81)	22.89(2.91)

From table 2 we discussed the children IQ score percentage with maternal smoking status according to different age group of children. From the 11-13 age group children, there were 30 number of mother gave premature birth with 1.13 and 0.345 mean and Standard deviation, maternal smoking habit during pregnancy fall into different category viz. Smoker 4(13.3%) , Non smoker 26(86.7%), and mother who gave full term birth to children was found 240 in size with their Mean and standard deviation was 1.075 and 0.279, maternal smoking habit fall into different category of smoking during pregnancy viz. Smoker 17(7.1%), Non smoker 223(92.9%). In the 13-15 age group children, there were 84 number of mother gave premature birth with 1.095 and 0.295 mean and standard deviation, maternal smoking habit fall into different category of smoking during pregnancy viz. Smoker 8(9.5%), Non smoker 76(90.5%) and mother who smoke during pregnancy gave full term birth to children was found 487 in size with their Mean and Standard deviation was 1.080 and 0.286, maternal smoking habit fall into different category of smoking during pregnancy viz. Smoker 37(7.6%), Non smoker 450(92.4%). From the 15-17 age group children, there were 6 number of mother gave premature birth with 1 and 0.00 mean and Standard deviation, maternal smoking habit fall into different category of smoking during pregnancy viz. Smoker 0%, Non smoker 6(100%) and mother who smoke during pregnancy gave full term birth to children was found 1.030 and 0.174 mean and Standard deviation, maternal smoking habit fall into different category of smoking during pregnancy viz. Smoker 1(3.0%), Non smoker 32(97.0%).

Table 2: Maternal Smoking Status who gave birth to Preterm and Full-term according to Age group of Children.

		Preterm Delivery	Full term Delivery	Chi-sq. (Sig.)
Age 11-13	Smoker	4(13.3%)	17(7.1%)	1.832 (0.400)
	Non Smoker	26(86.7%)	223(92.9%)	
	Total(n)	30	240	
	Mean(SD)	1.13(0.345)	1.075(0.279)	
Age 13-15	Smoker	8(9.5%)	37(7.6%)	
	Non Smoker	76(90.5%)	450(92.4%)	
	Total(n)	84	487	
	Mean(SD)	1.095(0.295)	1.080(0.286)	
Age 15-17	Smoker	0%	1(3.0%)	
	Non Smoker	6(100%)	32(97.0%)	
	Total(n)	6	33	
	Mean(SD)	1(0.00)	1.030(0.174)	

After applying the Chi-square test we found the p=0.40(p>0.05) this indicate that there is no association between the maternal smoking habit and type of delivery of mother.

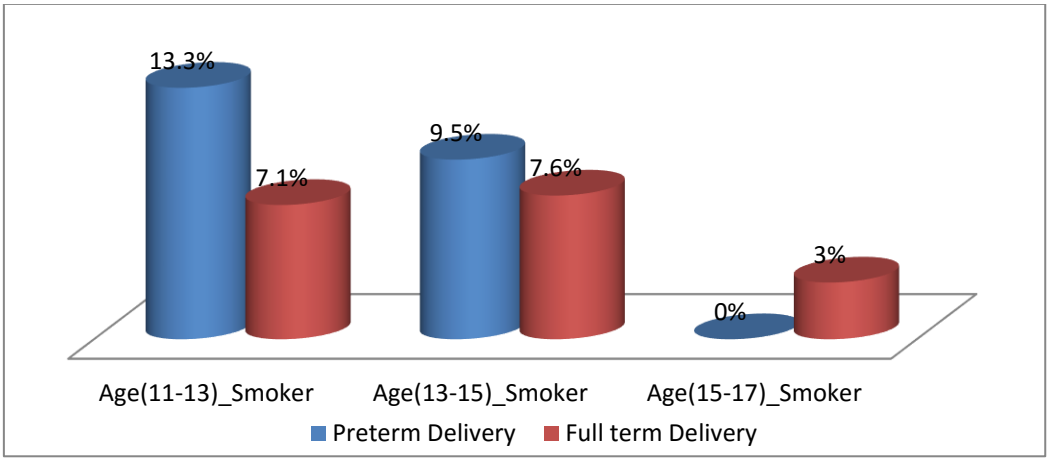

Figure 1: Represent the Mother smoking status who gave birth to Preterm delivery and Full-term delivery whose children the age group 11-13, 13-15 and 15-17.

In the table 3 by using Pearson chi-square test we found that there is association between children IQ score and maternal smoking habit during pregnancy. First we set null hypothesis H_0: There is no significant difference association between children IQ and maternal smoking habit during pregnancy v/s H_1: There is significant difference association between children IQ and maternal smoking habit during pregnancy. We found the p-value of chi-square is 0.041(<0.05) thus we conclude that there is association between children IQ and maternal smoking habit during pregnancy.

Table 4.3: Association between Children IQ and Maternal smoking habit (n=880).

Maternal Smoking Habit	Children Intelligence Quotient Score				Chi-sq. (Sig.)
	Superior	Normal	Borderline	Feebleminded	
Non-Smoker	37(4.6%)	256(31.5%)	349(42.9%)	171(21%)	6.101 (0.04)
Smoker	6(9.4%)	26(38.8%)	27(42.2%)	8(11.9%)	

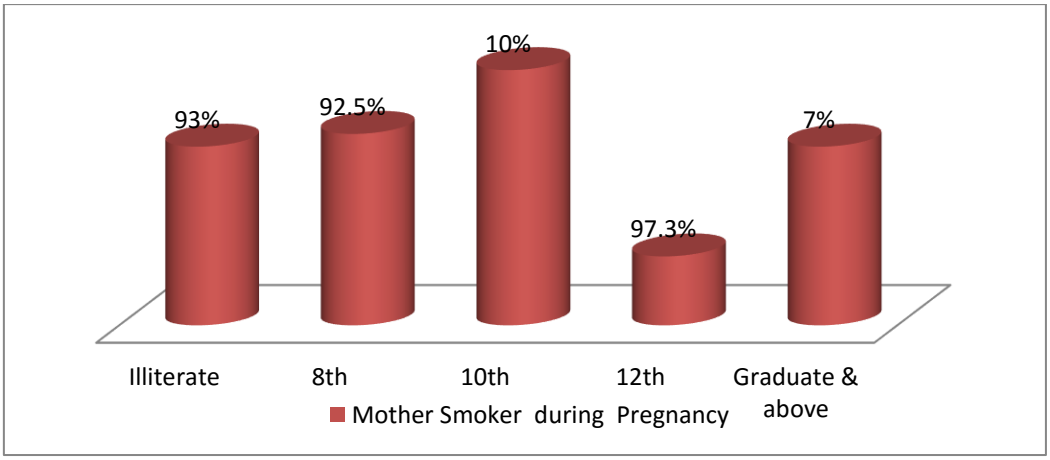

Figure 2: Represent the Association of Mother Smoking habit with their Educational Qualification.

In table 4 we study the maternal characteristics associated with smoking habit viz Non smoker, Smoker during pregnancy. Here we found the percentage of mother educational status with smoking habit of mother during pregnancy. Illiterate mother who smoke during pregnancy was 13(7.0%). The 8th pass mother who smoke during pregnancy was 27(7.5%). 10th pass mother who smoke during pregnancy was 22(10%). In the category of 12th pass mother who smoke during pregnancy was 2(2.7%). Mother whose educational status is Graduate & above who smoke during pregnancy was 3(7%). We also found the percentage of mother who smoke during pregnancy according to residential area wise were 22(4.6%) and 45(11.2%) in urban and rural category. In this table we also found the percentage of mother who gave birth to a child of preterm category was 12(10%) smoker and in full term category 55(7.2%) smoker. From the result table we found the mean and standard deviation

of maternal marriage age with smoking habit of mother during pregnancy were categorized into Non smoker 22.41(2.90) and Smoker 22.2(2.96).We use chi-square test to check the association between smoking habit of mother with their education status, residential area wise and type of delivery. We apply Chi-square test to check the association between variables, we found that the p-value in all the cases is ($p<0.05$) this means mother smoking habit was associated with their education status, residential area wise and type of delivery.

Table 4: Maternal characteristics associated with Smoking (n=880).

Variables		**Non Smoker during Pregnancy (n=813)**	**Smoker during pregnancy (n=67)**	**Chi-sq. (Sig.)**
Mother Education	Illiterate	172(93%)	13(7.0%)	4.569 (0.05)
	8th	331(92.5%)	27(7.5%)	
	10th	197(90%)	22(10%)	
	12th	73(97.3%)	2(2.7%)	
	Graduate & above	40(93%)	3(7%)	
Area	Rural	355(88.8%)	45(11.2%)	13.78 (0.001)
	Urban	458(95.4%)	22(4.6%)	
Type of Delivery	Preterm	108(90%)	12(10%)	12.04 (0.04)
	Full term	705(92.8%)	55(7.2%)	
Maternal Marriage Age (Mean & S.D)		22.41(2.90)	22.2(2.96)	

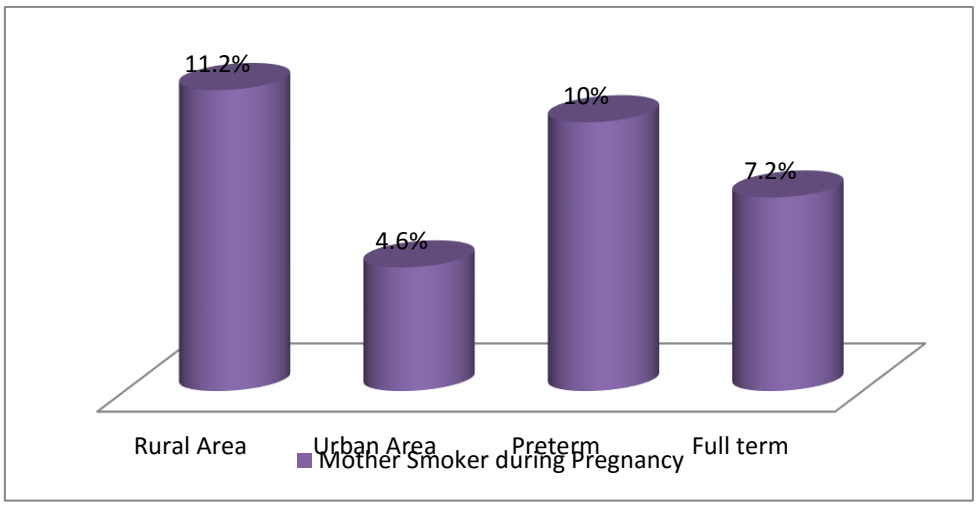

Figure 3: Represent the Association of Mother Smoking habit with respect to their Residential Area wise and Type of Delivery wise.

Variable of the study

The dependent variable was IQ level of children, which was categorized as Superior, Normal, Borderline and Feebleminded.

Table 5: Nature of the dependent variable with the corresponding code.

Categories	Code
Superior	1
Feebleminded	2
Borderline	3
Normal	4

The independent variables that used in this study are Alcohol habit of father, Smoking of father, Chewing habit of father, Health status of father, Alcohol habit of mother, Smoking of mother, Chewing habit of mother, Health status of mother, Mode of delivery and Type of delivery.

Table 6: List of dependent variable with the respective name and category codes.

Description	Value labels
Alcohol habit of father	1=Yes and 0=No
Smoking of father	1=Yes and 0=No
Chewing habit of father	1=Yes and 0=No
Health status of father	1=Yes and 0=No
Alcohol habit of mother	1=Yes and 0=No
Smoking of mother	1=Yes and 0=No
Chewing habit of mother	1=Yes and 0=No
Health status of mother	1=Yes and 0=No
Mode of delivery	1=Normal delivery and 0=Caesarean
Type of delivery	1=Full term and 0=Preterm Delivery

Ordinal Logistic Regression

We used ordinal logistic regression model in order to examine the effects of Prenatal Alcohol and Smoking Exposure on Children IQ.

Logit model for school children is as follows

$$\text{Prob (a given school children is malnourished)} = \frac{\text{Exp}(\beta x)}{1+\text{Exp}(\beta x)}$$

The logistic regression can be understood simply as finding β parameters that best fit.

Table 7: Model Fitting Information.

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	199.789			
Final	179.051	7.998	5	.049

In the Model Fitting Information the p value is 0.49($p<.05$).
The Statistically significant chi-square Statistic ($p=.049$) indicate that the final model gives a significant association between the dependent and independent variables

Table 8: Goodness of Fit Statistics.

	Chi-Square	df	Sig.
Pearson	66.370	57	.003
Deviance	73.718	57	.077

From the above table the results for our analysis suggest the model does fit very well ($p<0.05$).

Table 9: Pseudo R-Square.

Cox and Snell	0.444
Nagelkerke R^2	0.434
McFadden	0.031

What constitutes a good R^2 value depends upon the nature of the outcome and the explanatory variables. Here the pseudo R^2 values (e.g. Nagelkerke = 43%) indicates that there is relatively small proportion of the variation of Prenatal Alcohol and Smoking Exposure on Children IQ.

Table 10: Parameter Estimates of Ordinal Logistic Regression.

	β	SE	Wald	df	Sig.	Odd ratio	95% CI	
							LB	UB
IQ_Superior	-5.468	1.591	11.807	1	0.001	0.004	-8.587	-2.349
IQ_Severe	-3.006	1.583	3.603	1	0.051	0.049	-6.109	0.098
IQ_Borderline	-1.076	1.581	0.463	1	0.040	0.340	-4.174	2.022
Alcohol_Fathr_Y	0.126	0.134	0.881	1	0.034	1.133	.173	0.388
Alcohol_Fathr_N	0^a			0				
Smoke_Father_Y	0.47	0.150	0.099	1	0.044	1.04	-.246	0.341
Smoke_Father_N	0^a			0				

Chew_Father_Y	0.098	0.165	0.356	1	0.021	1.10	-.225	0.422
Chew_Father_N	0^a			0				
Health_Fathr_Y	-0.271	0.185	2.148	1	0.143	0.762	-.633	0.455
Health_Fathr_N	0^a			0				
Smoke_Mothr_Y	-1.791	1.146	2.443	1	0.049	0.166	-4.037	.455
Smoke_Mothr_N	0^a			0				
Alcohl_Mothr_Y	0.057	0.439	0.017	1	0.021	1.058	-.803	0.917
Alcohl_Mothr_N	0^a			0				
Chew_Mother_Y	-0.452	1.081	0.408	1	0.049	0.636	-2.808	1.428
Chew_Mother_N	0^a			0				
Health_Mothr_Y	-0.216	0.192	1.264	1	0.046	0.805	-.593	0.161
Health_Mothr_N	0^a			0				
Mode_delivery_N	0.135	0.127	1.131	1	0.280	0.144	-.114	0.384
Mode_delivery_C	0^a			0				
Type_delivery_P	-.382	0.185	4.283	1	0.034	0.682	-.744	-.020
Type_delivery_F	0^a			0				

In the ordinal logistic regression table we found that the p <0.05 value in case of Alcohol intake father, smoking habit of father, chewing habit of father, mother smoking during pregnancy, alcohol intake of mother, chewing habit of mother, health status of mother and type of delivery thus we conclude all these variable of prenatal exposure of father and mother is associated with the children IQ. Thus these variables of prenatal exposure affect the IQ of school going children, whereas in case of health status of father and mode of delivery p>0.05, we conclude that these 2 variable of prenatal exposure doesn't associated with the IQ of school going children. When we study the odd ratios of alcohol intake of father, smoking and chewing habit of father, the odd ratio of alcohol intake of mother i.e. 1.133, 1.04 and 1.10, 1.058 were greater than 1 as compare to odd ratio of other variables, so we conclude that these variables of Prenatal exposure of father and mother were mostly affected the IQ of children.

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Logit Model for Complete Sample Analysis

$$= 0.26\times \text{Alco\_habit\_Father} + 0.47\times \text{Smoke\_habit\_Father} + 0.098\times \text{Chew\_Father} - 0.271\times \text{Health\_Father} - 1.791\times \text{Smoke\_habit\_Mother} + 0.057\times \text{Alco\_mother} - 0.452\times \text{Chew\_habit\_Mother} - 0.216\times \text{Health\_Mother} + 0.135\times \text{Mode\_Delivery} - 0.382\times \text{Type\_Delivery}$$

Discussion and Conclusions

In our study we used chi-square test and ordinal logistic regression to check the association between children IQ and maternal smoking habit, prenatal exposure of father and mother. Smoking during pregnancy is likely to be one of the factors that affect the IQ of children. In our study we observed that the mother whose education qualification was graduate and above have highest rate of non smoker category 93% and mother whose education qualification was 10^{th} had highest rate of smoking in pregnancy 9.6%. By using Pearson chi-square test we found the value $p=0.041(p<0.05)$ this indicate that we reject null hypothesis and conclude that there is association between children IQ score and maternal smoking habit during pregnancy. We used Ordinal logistic regression to check the association between children IQ and Prenatal exposure of father and mother. In the parameter estimate table we found we found the $p <0.05$ value in case of Alcohol intake father, smoking habit of father, chewing habit of father, mother smoking in pregnancy, alcohol intake of mother, chewing habit of mother, health status of mother and type of delivery thus we conclude all these variable of prenatal exposure of father and mother is associated with the children IQ, and conclude that these variables of prenatal exposure affect the IQ of children, whereas in case of health status of father and mode of delivery $p>0.05$ this means that these two variables of prenatal exposure doesn't associated with the IQ of children. When we study the odd ratios of alcohol intake of father, smoking and chewing habit of father, the odd ratio alcohol intake of mother i.e. 1.133, 1.04 and 1.10, 1.058 were greater than 1 as compare to odd ratio of other variables, so we conclude that these variables of Prenatal exposure of mother and habit of father were mostly affected the IQ of children.

There were strong association between exposure to nicotine during pregnancy affected the cognitive function of new born child and leads to lower intelligence (Manzano et al., 2016). The association between prenatal smoking exposure and offspring risk of lower academic performance of children. The risk of poor intellectual performance was increased in sons of smoking mother as compare to sons of non-smoker mother (Lundbergs et al., 2010).

However when we collect the data according to Residential area wise then we found that the mother who smoke during pregnancy was 22(4.6 %) and 45(11.2%) in urban and rural area. Also we found that the mother who smoke during pregnancy gave birth to a child is 12(10%) in preterm and 55(7.2%) in full term. The lower reading score of children were significantly associated with risk factors for lower reading scores, lower maternal education and income of parents. Also Early childhood risk factors in premature and lower birth weight children lead to a cumulative risk for academic difficulties (Roberts et al., 2007).When we apply the chi-square test to check the association between the children IQ and Prenatal exposure of father and mother then we found that the value of chi-square is 0.359 ($p>0.05$) implies that we reject our null hypothesis, which means there is association between children IQ and Prenatal exposure of father and mother and then we found that the children with Superior IQ level have good prenatal score and children who fall into feeble minded category have poor prenatal score. Thus we conclude that the children IQ status mostly affected by the prenatal exposure of father and mother. Maternal smoking during pregnancy is related to the IQ of offspring. Based on these studies and proposed sample survey a new model for IQ estimation and its relation to various socio-economic, demographic, anthropometric, nutritional etc factors would be simulated to provide better and robust estimates (Bresalau et al., 2005). The intelligence Quotient of school children delivered by Cesarrean section and vaginal delivery found that the c-section delivery group had significantly higher IQ test scores, maternal and paternal educational levels were related to children's IQ scores. There was not any significant difference between IQ scores of c-section and vaginal delivery group (Khadem et al., 2010). The Effects of Prenatal Alcohol Exposure shows that alcohol during gestation can cause persistent abnormalities and cognitive development. The effect of prenatal alcohol exposure can be influenced by maternal maternal characteristics or by postnatal environment (Larkby et al., 1997).

KEY RESULTS

⇨ Maternal smoking during pregnancy is a proxy for vulnerable factors for adverse child cognitive development.

⇨ there is statistical association between children IQ and Prenatal exposure of father and mother and is highly confounded with other factors in children's cognitive development

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